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NORTHERN SOUTHEASTERN ALASKA PINK SALMON (Oncorhynchus gorbuscha) TAGGING INVESTIGATIONS, 1977-1980

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ABSTRACT

A major pink salmon (*Oncorhynchus gorbuscha*) adult tagging study was accomplished between 1977 and 1980 in Chatham Strait and Frederick Sound, northern Southeastern Alaska. The objectives were to investigate the migration routes, run timing, and degree of stock intermingling of major pink salmon stocks passing through these areas. Chartered purse seine fishing vessels were employed to capture fish. A total of 16,132 tagged pink salmon was released in 1977, 18,020 in 1978, 11,532 in 1979, and 11,172 in 1980. Tagging sites between some years overlapped but generally varied as the study moved from upper Chatham Strait southward towards lower Chatham Strait and Frederick Sound. Highly visible Peterson disc tags were used to facilitate maximum spawning ground tag recovery. Spawning ground surveys in 112 to 158 different streams within northern Southeastern Alaska totaled 355 in 1977, 252 in 1978, 145 in 1979, and 223 in 1980. A total of 14.4%, 21.4%, 17.8%, and 13.4%, respectively of the tags released was recovered during the 4 years of the study.

The distribution of recovered pink salmon illustrated that the majority of upper Regulatory Districts 108 and Districts 109-115 pink salmon stocks enter the "inside" waters of northern Southeastern Alaska via Icy Strait. Once inside, these stocks distributed themselves northerly, southerly, or both (especially District 111). Several of these stocks exhibited a variety of migration "sag" patterns before continuing to their natal streams. The lack of significant numbers of tag recoveries in lower Chatham streams from upper Chatham Strait release locations and vice versa confirms this pattern of migration and distribution.

Pink salmon migration was indicated to occur in somewhat of an orderly manner through the tagging areas. Peak run timing periods were evident for individual stocks and larger units suggesting that effective management strategies might be devised by adjusting fishing seasons to peak periods to protect or direct the harvest to selected stocks. However, this approach may be limited by stock intermingling, especially during the month of July.

INTRODUCTION

The identification of migration routes, run timing, and degree of stock intermingling is information critical to the management of Southeastern Alaska salmon resources. This information is needed to devise salmon management strategies based on the individual stock concept. The purpose of this paper is to present the results of a major pink salmon (*Oncorhynchus gorbuscha*) tagging study accomplished by the Stock Separation Research Project of the Alaska Department of Fish and Game (ADF&G) between 1977 and 1980 in northern Southeastern Alaska.

Southeastern salmon resources are composed of a heterogeneous group of stocks. Somewhat over 2,000 anadromous streams of varying size, productivity, and run timing are situated on the many islands and the mainland within the region. The waterways through which these fish migrate and are harvested are composed of a complex system of straits, inlets, and bays. These can provide for a variety of possible migration routes and dictate that many different stocks must follow along the same route. These factors combine to create an extremely mixed stock fishery situation.

The tagging study was prompted by the realization that a serious informational gap was preventing effective management of major Southeastern mixed stock fisheries. More precise information about migration routes, run timing, and stock intermingling through major fishing areas was needed to improve the management of Southeastern salmon resources.

OBJECTIVES

The major objective of the Southeastern Stock Separation Research Project is to define and/or develop stock separation techniques that will be adaptable toward improving the management of the Region's salmon resources. As an initial endeavor a major pink salmon tagging study was accomplished in northern Southeastern Alaska. The objectives of this study were to determine:

- 1) the time period that major pink salmon spawning stocks migrate through Chatham Strait and Frederick Sound,
- 2) along which side of Chatham Strait and Frederick Sound major pink salmon stocks migrate, and
- 3) the spawning stream distribution of pink salmon migrating through Chatham Strait and Frederick Sound.

PREVIOUS TAGGING STUDIES

A considerable amount of pink salmon tagging has been accomplished in northern Southeastern Alaska (Table 1). From the earliest investigations by the U.S.

Table 1. Pink salmon tagging in northern Southeastern Alaska, 1924-1962.

Year	Location	Inclusive Dates	Number of Releases	Source
1924	Inian Islands	July 7-14	137	Rich, 1926
1924	Cape Bendel	Aug. 4	573	Rich, 1926
1924	Kingsmill Pt.	Aug. 7	353	Rich, 1926
1925	Pleasant Island	June 23-24	5	Rich, 1926
1925	Inian Islands	June 25-27	305	Rich, 1926
1925	Pt. Adolphus	July 1	35	Rich, 1926
1925	Eagle Pt.	July 1	10	Rich, 1926
1925	Hourigan Pt.	July 10	152	Rich, 1926
1925	Kingsmill Pt.	July 11-15	387	Rich, 1926
1926	Cape Bendel	July 15-18	3,177	Rich and Suomela, 1927
1926	Parker Pt.	July 20-22	927	Rich and Suomela, 1927
1926	Inian Island	July 24-29	1,804	Rich and Suomela, 1927
1926	Douglas Island	July 31-3 Aug.	794	Rich and Suomela, 1927
1927	Parker Pt.	July 1-12	128	Rich and Morton, 1928
1927	Carroll Island	July 9	17	Rich and Morton, 1928
1927	Hourigan Pt.	July 9-19	271	Rich and Morton, 1928
1927	Marble Bluff	July 12	90	Rich and Morton, 1928
1927	Inian Islands	July 14-16	398	Rich and Morton, 1928
1927	Pleasant Island	July 16	362	Rich and Morton, 1928
1927	Cape Bendel	July 20	347	Rich and Morton, 1928
1927	Pt. Hobart	July 21	115	Rich and Morton, 1928
1938	Pt. Ellis	July 7-12 Aug.	2,094	Nakatani et al, 1975
1939	Pt. Ellis	July 11-13 Aug.	2,100	Nakatani et al, 1975
1940	Wilson Cove	Aug. 12-16	1,399	Nakatani et al, 1975
1940	Hawk Inlet Shore	Aug. 13	500	Nakatani et al, 1975
1940	Pt. Augusta	Aug. 13	500	Nakatani et al, 1975
1941	Inian Islands	July 12-5 Aug.	2,597	Nakatani et al, 1975
1941	Pt. Adolphus	Aug. 7	300	Nakatani et al, 1975
1941	Pt. Augusta	July 13-9 Aug.	1,749	Nakatani et al, 1975
1941	Pt. Caution	July 13	150	Nakatani et al, 1975
1941	Wilson Cove	July 20-17 Aug.	2,124	Nakatani et al, 1975
1941	Pt. Ellis	Aug. 10-16	700	Nakatani et al, 1975
1942	Inian Islands	July 18-2 Aug.	980	Nakatani et al, 1975
1942	Pt. Sophia	Aug. 9	495	Nakatani et al, 1975
1942	Pt. Augusta	July 25-18 Aug.	998	Nakatani et al, 1975
1942	Funter Bay	Aug. 9 - 16	997	Nakatani et al, 1975
1942	Pt. Hepburn	Aug. 16	321	Nakatani et al, 1975
1942	Wilson Cove	Aug. 11-15	673	Nakatani et al, 1975
1942	Pt. Ellis	Aug. 13	497	Nakatani et al, 1975
1945	Salisbury Sound	Aug. 5-12	1,357	Nakatani et al, 1975
1948	Gull Cove	July 22	47	Verhoeven, 1948
1948	Pt. Sophia	July 18-21	13	Verhoeven, 1948
1948	Pt. Adolphus	Aug. 15-28	650	Verhoeven, 1948
1948	Seal Bay	July 6-13	394	Verhoeven, 1948
1948	Hawk Inlet Shore	July 25-29	1,419	Verhoeven, 1948
1948	Marble Bluff	Aug. 10-25	1,127	Verhoeven, 1948
1948	Wilson Cove	Aug. 12-27	748	Verhoeven, 1948
1948	Pt. Caution	Aug. 12	76	Verhoeven, 1948
1948	Distant Pt.	Aug. 11-26	420	Verhoeven, 1948
1948	Killisnoo Island	Aug. 11	165	Verhoeven, 1948
1950	Pleasant Island	July 27-5 Sept.	8,278	Elling and Macy, 1955
1950	Pt. Adolphus	July 25-4 Sept.	7,317	Elling and Macy, 1955
1950	Cube Point	Aug. 20 - 3 Sept.	1,758	Elling and Macy, 1955
1950	False Bay	Aug. 21 - 3 Sept.	47	Elling and Macy, 1955
1961	Inian Islands	June 23 - 22 July	9,710	Vania et al, 1964
1961	Seymour Canal	June 21 - 22 July	4,586	Vania et al, 1964
1962	Inian Islands	June 19 - 4 Aug.	6,595	Vania et al, 1964

Bureau of Commercial Fisheries (1920's) to the most recent experiments by the ADF&G (1961-1962), about 75,000 tagged pink salmon had been released. Approximately 25,000 of these were later recovered. A vast majority of the recoveries came from the commercial fisheries. This information has been valuable in defining major entry ways and general migration pathways. An overview of these results was realized by combining the release and recovery information of the past investigations into major geographical areas (Table 2). In the analysis the following observations were of major interest.

- 1) A lack of recoveries from outside of northern Southeastern Alaska illustrated the integrity of this stock unit. All past tagging investigations have demonstrated a virtual separation of Southeastern pink salmon into distinct northern (north of Sumner Strait) and southern (Sumner Strait south) units (Figure 1).
- 2) Very few pink salmon released within the inside waters have been recovered on the outside coasts of Baranof and Chichagof Islands. Additionally, only minor movement has been indicated through Peril Strait from the outside coasts.
- 3) Major movements from Icy Strait into Chatham Strait and then southward and into Frederick Sound and Stephens Passage were illustrated.
- 4) A distinct movement from lower Chatham Strait into Frederick Sound was apparent.
- 5) Only a minor exchange of tagged pink salmon has been observed between the waters of upper and lower Chatham Strait and vice versa.

The commercial recovery information appears to indicate the presence of three major stock groups within northern Southeastern Alaska. The largest group, as illustrated by the catch record, enters through Icy Strait and distributes southward in Chatham Strait and then into the waters of Frederick Sound and Stephens Passage. A second inside water group enters through the southern entrance of Chatham Strait and distributes northward and into Frederick Sound. The third group consists of the pink salmon stocks of the outside coast.

It was not until the investigations of Elling and Macy (1955) in 1950 and Vania et al. (1964) in the early 1960's that the spawning grounds were surveyed for tagged fish. Most of the releases made during these experiments were in Icy Strait. Essentially no previous spawning ground recovery information is available for pink salmon entering lower Chatham Strait or the outside stocks. Their spawning stream recovery results demonstrated a complex movement to the spawning grounds and illustrated the mixed stock nature of northern Southeastern Alaska fisheries. These experiments were unsuccessful in segregating major spawning stocks according to time of passage through Icy Strait. Instead, a heterogeneous mixture of stocks was indicated throughout the season and many streams demonstrated a wide variation in the time of passage through Icy Strait. However, the utility of the 1950 experiments was limited by the timing of releases and inadequate tag recovery efforts which hindered the data interpretation for both studies. The 1950 tagging was not initiated

Table 2. Summary of commercial recoveries of pink salmon tagged in northern Southeastern Alaska, 1977-80.

Tagging Area	Number of Releases	Number of Recaptures	<u>Percent of Total Recaptures in Area</u>							
			Icy Strait	Lynn Canal	Upper & Middle Chatham Strait	Lower Chatham Strait	Frederick Sound & Stephens Passage	Outside Coasts of Northern Southeast	Outside of Northern Southeastern	Unknown
Icy Strait	39,969	14,565	38.3	1.1	35.9	3.0	11.4	0.2	0.6	9.4
Upper & Middle Chatham Strait	16,176	5,860	4.4	0.1	56.0	2.7	30.2	0.1	0.3	6.3
-4- Lower Chatham Strait	5,570	1,404	0	0	5.3	45.4	43.9	0.1	4.2	0.3
Frederick Sound & Stephens Passage	9,589	3,273	1.0	0.1	4.4	1.3	90.4	0	0.9	1.1
Outside Coasts of Northern S.E.	1,357	456	0	0	7.7	0	0	92.1	0.2	0

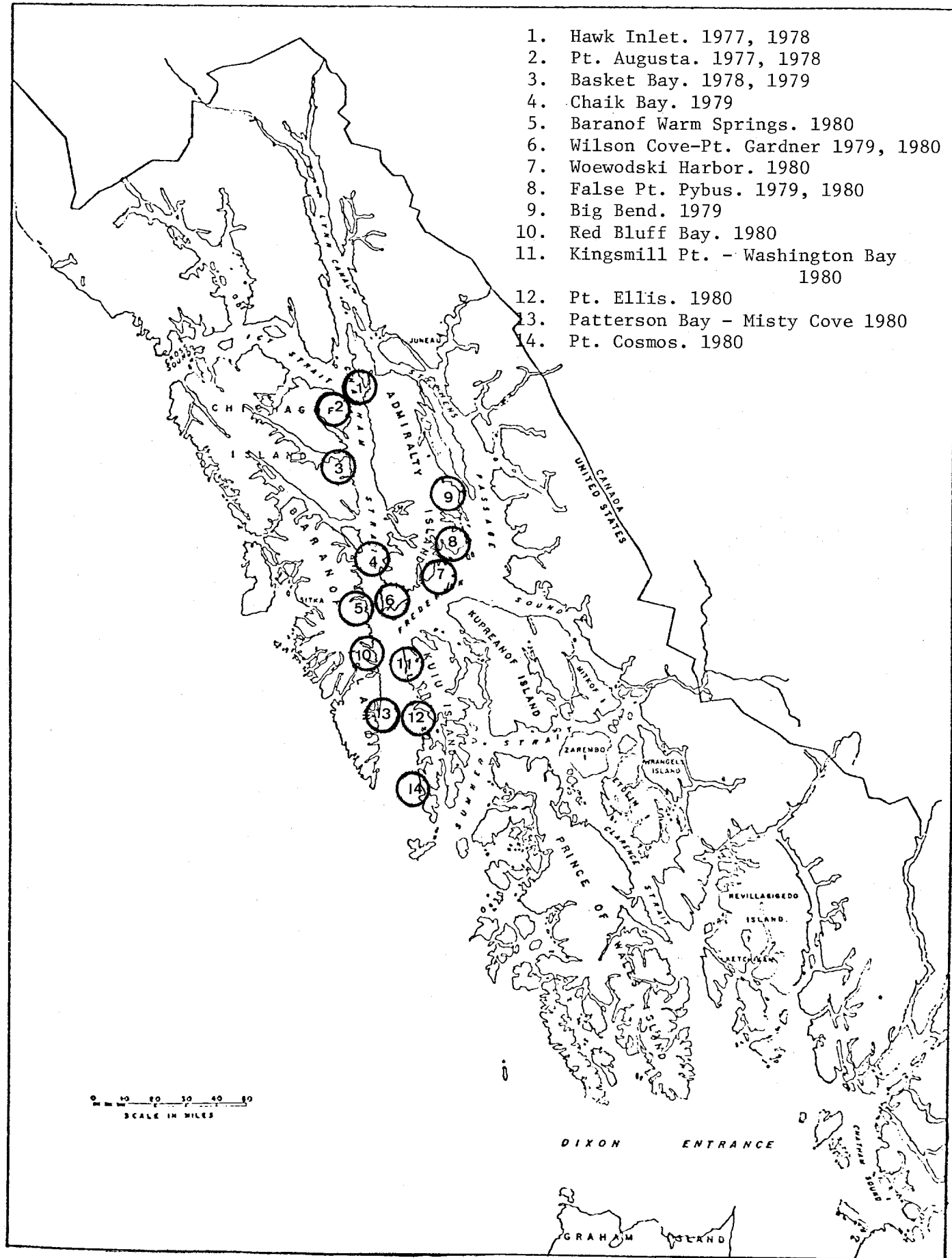


Figure 1. Map of Southeastern Alaska showing 1977-80 tagging areas.

until the end of July and escapements to early run areas were noted to be well in progress prior to this time. Only 101 tags were recovered from the spawning grounds in 1961, and 246 in 1962.

In summary, a considerable amount of previous tagging work had been accomplished. The investigations demonstrated the complex nature of pink salmon movements, defined major entry ways, and identified important migration pathways. However, more precise movement and timing information in regard to major fishing areas was needed for effective salmon management (Larson 1978).

METHODS

Chartered purse seine fishing vessels were employed to capture pink salmon. During 1977, the ICY QUEEN, operated by Merle Enloe, and the LAKE BAY, operated by L.O. Lewis were employed, while in 1978, the ST. PETER, operated by Ronald John Sr., and the AMBER LEE, operated by Edward Dunn Jr., were chartered to capture pink salmon. The fishing vessel ST. PETER was chartered again in 1979 along with the vessel DOROTHY JEAN, operated by Nels Otness, while in 1980, the vessel MIDNIGHT CHARGER, operated by John Martin Kristovich, was employed to capture fish.

Pink salmon were tagged and released from the end of June through August during 1977 and 1978, and the first of July through 15 August in 1979 and 1980. Tagging locations varied considerably during the 4 years of the study, with some overlap occurring between the first two and the second 2 years of this project (Figure 1).

Tags Employed

Highly visible, numerically sequenced, Peterson disc tags were employed to facilitate maximum spawning stream recovery. Each tag consisted of two plastic discs, a 3 inch (7.62 cm) soft stainless steel needle, and a 1/4 inch (6.35 mm) clear plastic baffle (1977 only). During 1977 most of the tags were 3/4 inch (19.05 mm) in diameter; however, some 5/8 inch (15.85 mm) discs, surplus from previous tagging studies, were used. One disc from each tag set was numbered and had printed on it "ADF&G Juneau - Reward". Following completion of the 1977 study a decision was made to eliminate the clear 1/4 inch (6.35 mm) plastic baffle. Between 1978 and 1980 solid red, numerically sequenced, 3/4 inch (19.05 mm) diameter tags were employed to facilitate spawning ground tag recovery.

Tagging Operations

Standard purse seining methodologies were employed to capture fish. However, at the termination of each set, instead of hoisting the bag end of the seine net aboard, a holding pen of appropriate size was formed by using the seine skiff to support the webbing out from the boat. Individual fish could then be removed with a dip net for tagging. Fish were tagged aboard the seine boat and/or in the seine skiff.

The pink salmon were extremely small in 1978 which caused a persistent problem of fish being gilled in the seine webbing as the gear was hauled. This hindered the fishing process and on occasions up to 1-1/2 hours were required to haul the gear. Because of this problem a modified tagging operation was initiated during mid-July to process some of the gilled fish as the gear was being hauled instead of being removed from the webbing and placed back into the purse seine. From 17 July to 9 August 1978 a total of 1,293 pink salmon was tagged and released in this manner. A comparison of recovery rates, in sets where both tagging methods were employed, showed little difference between the gilled fish that were tagged and released (25.4% recovered) and those processed in the normal manner (25.0% recovered).

Portable tagging equipment was necessary, which consisted of tagging boxes, stands, dipnets, and tags arranged in numerical order. The tagging boxes were constructed of wood with the top side open to permit a soft piece of canvas to be suspended, forming a "V" shaped enclosure, into which fish could be placed. Pieces of styrofoam were placed between the canvas and the sides of the box to hold the fish in place and serve as protection while the tags were applied. The numbered discs were arranged in numerical order and pinned to styrofoam reels. The reel consisted of a 6 inch (15.24 cm) diameter styrofoam spool, approximately 12 inches (30.48 cm) long, that was placed on a wooden dowel which, when mounted on the tagging table, would rotate for easy dispensing of the tags.

The fish were dipped individually from the seine and placed on the tagging table. One member of the tagging team held the fish while the other completed the tagging. With the aid of long nose pliers the 3 inch (7.62 cm) pin, with numbered disc attached, was forced through the fish just forward of the dorsal fin. An unnumbered disc was next placed on the opposite side and the pin was trimmed so that approximately 3/4 of an inch (19.05 mm) remained. The portion of the pin extended beyond the disc was then twisted to form a knot (Figure 2). This completed the tagging operation and the fish was released. Generally, two tagging teams were used and after some experience was obtained, 300-400 fish could be processed per hour.

Some scaling and smothering occurred during the tagging; however, the number of fish injured was insignificant in comparison to the total catch. The most persistent problem encountered was the large amount of jellyfish captured during the seining. The "jelly" would accumulate in the bag of the seine and had to be removed to prevent injury to the captured fish. Sometimes this removal would require 20-30 minutes to complete.

Tag Recovery

Tag recovery efforts were directed toward the spawning grounds and the commercial and sport fisheries. A 1 dollar reward was offered in 1977, 1978, and 1979, while a 2 dollar reward was offered in 1980 to encourage voluntary tag returns. Southeastern catch samplers were instructed to be on the alert for tagged fish and a news release was provided to the local news media informing the public of the releases and describing what to do with recovered fish.



Figure 2. Fish and Game employees placing Peterson disc tags on pink salmon.
(Alaska Department of Fish and Game photos by Gary Gunstrom).

The recovery of tagged fish from the spawning grounds was given the most emphasis. From 112 (1977) to 158 (1980) major pink salmon spawning streams within the "inside" waters of northern Southeastern Alaska were selected as primary recovery areas. The selection was based on spawning capacities, suitability for recovery, and geographical distribution.

Only those streams with an average historical escapement (1960-1976) of over 1,000 pink salmon were included in the selection process. Spawning streams located westward of Port Frederick in Icy Strait and those on the outside coasts of Baranof and Chichagof Islands were not included because past tagging records indicated only very minor movement to those areas from the tagging locations. Some streams were not considered suitable for tag recovery because of large size, excessive depth, or clarity. In general, every major pink salmon spawning stream, where recovery was feasible and had expected returns migrating through Chatham Strait, was included as a primary recovery stream.

The timing of surveys was considered the critical factor for successful recovery. Computer summarized stream escapement records were reviewed to determine the peak spawning time. Tag recovery surveys were scheduled 2 weeks prior to, during, and 2 weeks after usual peak spawning time. Additional streams were surveyed as time permitted.

Tag recovery was accomplished by employing five-prong spears attached to 12-foot (36.60 m) poles. This method was quite effective on the spawning riffles; however, while fish were schooling in deep pools it was difficult to complete recovery. Additionally, the crews examined dead fish and many tags were recovered in the process (Figure 3).

Data Analysis

A data file was established on the University of Alaska computer terminal network system to store the tag and recovery information. A computer program devised by Ivan Frohne (ADF&G Senior Biometrician, Juneau) was used to edit and sort the tag and recovery data for analysis.

Ancillary Studies

Ancillary studies to investigate alternative methods of stock separation were undertaken as part of this project. Scale pattern discriminant function analysis and electrophoresis were the two techniques considered.

In 1978, 100 pink salmon scales were collected from each of several streams in three major spawning areas of northern Southeastern Alaska. Scales were collected from four spawning locations within Tenakee Inlet: Seal Bay, Big Goose Creek, Kadashan Creek, and Crab Bay. Two spawning streams within Seymour Canal were also sampled: Pleasant Bay and Mole River. Finally, three streams were sampled in Peril Strait: Patterson Bay, Saook Bay, and Appleton Cove. Once collected, the scales were turned over to the Anchorage Stock Separation Center where several data variables were then measured from the plastic impressions using standard scale measuring methods as described by Krasnowski and Bethe (1978).



Figure 3. Fish and Game employees recovering Peterson disc tags.
(Alaska Department of Fish and Game photos by Gary Gunstrom).

The scale pattern data were then analyzed by discriminant function analysis (Nie, et al. 1975) and other statistical techniques (Pella and Robertson 1978). The objective of these analyses was to determine if the measured data could be used to construct a model which could accurately classify scale sample data from pink salmon of unknown origin. Accurate classification was defined as the stock composition estimates of an unknown sample which would be precise enough to allow management decisions and/or catch allocations to be based on these estimates (Robertson 1978, memo).

Electrophoretic techniques were also considered during the course of the study. However, due to the expense involved, the length of processing time (up to a week), and concurrent work by graduate students at the University of Alaska, Juneau, who failed to show this method effective for separation of major pink salmon stocks within northern Southeastern Alaska, this technique was not pursued.

RESULTS

The results presented in this report are based on the 1977-80 Chatham Strait and Frederick Sound tagging investigations. Encompassed within this report is a summary of the results obtained from the 1977, 1978, 1979, and 1980 field seasons.

Tagging

Pink salmon tagging in 1977 was initiated on 22 June and continued until 28 August. During this period, 32 days of tagging was accomplished. A total of 16,132 tagged pink salmon was released, including 6,172 along the Point Augusta shoreline (Table 3 and Figure 1) and 9,960 along the Hawk Inlet shoreline.

Tagging of pink salmon in 1978 commenced on 23 June and continued until 26 August. During this period 31 days of tagging were accomplished. A total of 18,020 pink salmon was tagged and released, including 6,021 near Point Augusta, 6,816 on the Hawk Inlet shore, and 5,183 along the Basket Bay shoreline (Table 4).

A slight decrease in the number of tagging days and fish released occurred in 1979. Twenty six June marked the beginning of tagging, which continued until 3 August, resulting in a total of 22 days of tagging. A total of 11,532 pink salmon was tagged and released, including 5,381 along the Basket Bay shore, 1,057 between Chaik Bay and Point Gardner, and 5,094 along the False Point Pybus - Big Bend shore (Table 5).

The final year of tagging was conducted in 1980. Tagging started on 8 July and ended on 15 August for a total of 24 days. Due to the wide dispersion of release sites, only 11,172 pink salmon were tagged and released, including 1,847 along the False Point Pybus - Woewodski Harbor shore, 3,097 between Point Gardner and Wilson shoreline, 1 at Baranof Warm Springs, 79 at Red Bluff Bay, 5,828 at Kingsmill Point-Washington Bay shoreline, 5 at Point Ellis, 50 at Patterson Bay-Misty Cove shoreline, and 265 at Point Cosmos (Table 6).

Table 3. Number of pink salmon tagged and released, northern Southeastern Alaska, 1977.

Tagging periods for 1977	Point Augusta		Hawk Inlet		Total
	Date	Number	Date	Number	
Late June	23,26,27,28 June	548	22,24,25,29 June	557	1,105
Early July	7,13,14,15 July	3,425	6,8,12 July	2,483	5,908
Late July	21,22 July	1,636	19,20 July	1,997	3,633
Early August	7,12,13 August	541	8,9,10,11,14 August	3,663	4,204
Late August	25 August	22	24,26,27,28 August	1,260	1,282
Season Total	14 days	6,172	18 days	9,960	16,132

Table 4. Number of pink salmon tagged and released, northern Southeastern Alaska, 1978.

Tagging periods for 1978	Point Augusta Shoreline		Hawk Inlet Shoreline		Basket Bay Shoreline		Total
	Date	Number	Date	Number	Date	Number	
Late June	23,26 June	684	24,25,27 June	267	No tagging		1,251
Early June	2,4,5,9 July	2,655	1,3,8,10 July	1,398	6,7 July	1,547	5,600
Late July	17,19 July	1,455	16,18,20,26	3,284	21,25 July	1,838	6,577
Early August	2 August	459	3 August	387	7 August	407	1,253
Late August	24,25 August	768	22,23 August	1,180	26 August	1,391	3,339
Season Total	11 days	6,021	14 days	6,816	6 days	5,183	18,020

Table 5. Number of pink salmon tagged and released, northern Southeastern Alaska, 1979.

Tagging periods for 1979	Basket Bay Shoreline		Chaik Bay Shoreline		Point Gardner Shoreline		False Point Pybus Shoreline		Big Bend Shoreline		Total
	Date	Number	Date	Number	Date	Number	Date	Number	Date	Number	
Late June	26,27 June	23	-	-	-	-	-	-	-	-	23
Early July	2,3,5,9	3,436	7,8 July	356	7,8 July	187					3,979
Late July	18,31	1,195	19 July	291	-	-	25,26 July	2,245	27 July	1,053	4,784
Early Aug.	2 August	727	1 August	223	-	-	1,2 August	735	2,3 Aug.	1,061	2,746
Late Aug.	-	-	-	-	-	-	-	-	-	-	-
Season Total	9 days	5,381	4 days	870	2 days	187	4 days	2,980	3 days	2,114	11,532

Table 6. Number of pink salmon tagged and released, northern Southeastern Alaska, 1980.

Tagging period for 1980	False Point Pybus Shoreline		Woewodski Harbor Shoreline		Point Gardner Shoreline		Wilson Shoreline		Baranof Warm Springs Shoreline	
	Date	Number	Date	Number	Date	Number	Date	Number	Date	Number
Late June	-	-	-	-	-	-	-	-	-	-
Early July	-	-	15 July	42	-	-	11,15 July	597	11 July	1
Late July	16,29 July	1,200	-	-	-	-	26 July	645	-	-
Early August	8,15 August	79	7 August	526	7 August	771	2,7,12 Aug.	1,084	-	-
Late August										
Season Total	4 days	1,279	2 days	568	1 day	771	6 days	2,326	1 day	1

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Tagging period for 1980	Red Bluff Bay Shoreline		Kingsmill Point- Wash. Bay Shoreline		Point Ellis Shoreline		Patterson Bay- Misty Cove Shoreline		Port Cosmos Shoreline		Total
	Date	Number	Date	Number	Date	Number	Date	Number	Date	Number	
Late June	-	-	-	-	-	-	-	-	-	-	-
Early July			8,10 July	1,441	9 July	1	9 July	3	9 July	1	2,078
Late July	7 July	9	17,18,24,25, 31 July	2,499	24 July	4	23 July	47	24 July	121	4,525
Early August	1 August	70	9,14 August	1,888	-	-	-	-	13 August	143	4,561
Late August											
Season Total	2 days	79	9 days	5,828	2 days	5	2 days	50	3 days	265	11,172

Spawning Ground Tag Recovery

Spawning ground tag recovery efforts were initiated each year in mid-July and continued through September. As can be seen in Table 7 the number of surveys completed totaled 355 in 1977 (130 streams), 252 in 1978 (140 streams), 163 in 1979 (112 streams), and 223 in 1980 (135 streams). Yearly differences in the number of streams surveyed and total number of surveys conducted were caused by weather conditions, vessel availability, and odd-year - even-year differences¹ in the number of streams which met the basic selection process of a 1,000 pink salmon minimum escapement index. The majority of the recovery streams were surveyed twice. The timing of surveys was considered the critical factor for successful recovery. Stream management records were reviewed to determine peak spawning time. Tag recovery were then scheduled for two weeks prior, during, or two weeks after, the peak spawning time. The timing of the tag recovery surveys seemed adequate for good escapement coverage. A yearly comparison of the numbers of pink salmon observed during tag recovery efforts, and seasonal counts, indicated that a high percentage of the escapement was examined for tags in the primary recovery streams. Overall, the sum of the peak escapements observed on the spawning grounds during tag recovery in each year ranged from 68%-75% of the total of the peak counts noted in the "inside water" tag recovery spawning streams of northern Southeastern Alaska (Table 7).

Commercial Tag Recovery Efforts

Most of the commercial tag recoveries were reported from the northern Southeastern Alaska commercial net fisheries during the 4 years of study. Pink salmon catches varied considerably during this period (range, 0-16.6 million) as the majority of harvest occurred in southern Southeastern Alaska. On the other hand, catches in northern Southeastern Alaska, although significantly smaller, produced the majority of the tag returns from Districts 109, 110, 112, 113 (see Figure 4 for Southeastern Regulatory Districts) and the Taku-Snettisham or Lynn Canal gillnet fisheries in District 111 (Table 8). In addition, the commercial troll fisheries (and a few ocean sport fishery recoveries) accounted for a number of recoveries during the course of the study.

It would be impossible to determine the home streams of the tagged pink salmon recovered in the various net fisheries, however, whenever a majority of the harvest was confirmed to discrete areas, the recovered tags were allocated to distinct stock groups with a high degree of confidence. Thus, tagged pink salmon recovered in Tenakee Inlet, Peril Strait, Seymour Canal, Taku-Snettisham, and Lynn Canal fisheries were probably destined for local spawning streams and the tag recovery information could be utilized to describe total stock group migration patterns.

¹ Pink salmon have a 2-year life cycle and, therefore, have two distinct runs of odd- and even-year runs.

Table 7. Spawning stream tag recovery efforts and their accuracy when compared to annual escapement enumerations, northern Southeastern Alaska, 1977-1980.

Survey year	Number of streams surveyed	Number of surveys	Sum of peak stream ¹ escapements observed during tag recovery	Sum of seasonal ¹ peak observed escapements	Percentage
1977	130	355	1,120,000	1,539,306	73%
1978	140	252	1,524,000	2,244,000	68%
1979	112	163	1,317,082	1,767,225	75%
1980	135	223	999,476	1,399,728	71%

¹ Includes Districts 108-115 but only the inside water portions of District 113 - Peril Strait and Sitkoh Bay. See Figure 4 for Regulatory Districts.

Table 8. Northern Southeastern Alaska net fisheries, 1977-1980.

Fishery	Gear type	Number of pink salmon harvested				Number of tags recovered			
		1977	1978	1979	1980	1977	1978	1979	1980
Districts 101-108 Southern S.E.	Seine	5,769,000	11,418,000	5,836,000	16,646,000	2	5	0	3
	Gillnet	1,281,000	920,000	788,000	568,000	0	0	1	28
	Troll ²	132,000	89,000	166,000	282,000	1	0	0	2
District 109	Seine	29,000	530,000	1,192,000	206,000	0	0	8	250
	Troll	10,000	42,000	100,000	61,000	0	1	2	13
District 110	Seine	0	600	87,000	0	0	0	131	3
	Troll	2,800	3,000	4,000	5,600	0	0	0	1
District 111	Seine	0	0	8,000	0	0	0	0	0
	Troll	1,500	1,100	2,000	3,500	4	5	1	0
District 112	Seine	0	287,000	341,000	605,000	0	940	104	43
	Troll	11,000	8,600	18,000	35,500	20	23	2	1
District 113 ¹	Seine	0	0	0	1,525,000	4	886	0	0
	Troll	48,000	23,000	116,000	72,500	3	3	1	1
District 114	Seine	0	36,000	4,100	0	0	0	0	0
	Troll	57,000	29,000	86,000	120,800	9	6	0	0
District 115	Seine	0	0	0	0	0	0	0	0
	Troll	500	100	500	1,000	1	0	0	0
Taku-Snettisham	Gillnet	89,000	296,000	153,000	51,000	205	131	10	106
Lynn Canal	Gillnet	131,000	82,000	28,800	3,800	77	4	0	1

¹ Peril Strait and Sitkoh Bay only for purse seine gear.² Includes power troll, hand troll, and sport troll gear.

Tags Recovered

A total of 14.4%, 21.4%, 17.8%, and 13.4%, respectively, of the tags released was recovered during the 4 study years (Table 9). The majority of the stream recoveries (1,644, 1,610, 1,750, and 912, respectively) were recovered during instream tag recovery and escapement foot surveys conducted by ADF&G (Table 10). The public reward system accounted for 223, 154, 43, and 56 instream tag recoveries, while the saltwater sport catch returned 52 tags in 1977, 29 in 1978, and none in 1979 or 1980. Weirs operated by the National Marine Fisheries Service at Auke Creek (Auke Bay) and Sashin Creek (lower Baranof Island) turned in 78, 23, 5, and 29 tags, respectively. Finally, commercial seine harvests accounted for 6, 1,863, 248, and 305 tags while the gillnet fisheries returned 254, 129, 10, and 145 tags, respectively. The commercial troll fisheries, and returns from unknown methods of capture, accounted for the remaining tags (62, 45, 17, and 47).

Distribution of Recoveries

Tagged pink salmon were recovered over a widespread area (Appendix Table 1). However, relatively few tags were recovered in southern Southeastern Alaska (Districts 101-108; range 4-46), with the highest number of recoveries (41) occurring from 1980 released in District 109 (Appendix Table 1). Additionally, only a very small number of tags were recovered on the outside coasts of northern Southeastern Alaska. Thus, the distribution of recovered tags indicated that the pink salmon which pass through Chatham Strait and Frederick Sound were almost exclusively Southeastern Alaska "inside water" stocks of Districts 109-115.

Commercial tag recoveries were mostly from the northern Southeastern Alaska commercial seine fisheries in Districts 109, 110, 113 (1978 only), Chatham Strait, Tenakee Inlet, and the Taku-Snettisham or Lynn Canal (1977 only) gillnet fisheries (Appendix Table 1). Recoveries from the net fisheries indicated major portions of these catches migrated through Icy Strait, passed through Chatham Strait and into Lynn Canal, Frederick Sound, and/or Stephens Passage.

Scale Pattern Analysis

Analysis of the pink salmon scales collected in 1978 entailed construction of five different classification models for determining stock composition percentages from scales of an unknown origin. The models constructed were "All Systems", "Tenakee Inlet", "Seymour Canal", "Peril Strait", and "Area by Area". Discriminate analysis of these models determined that differentiating between any of the spawning areas (e.g., Tenakee Inlet, Peril Strait, Seymour Canal) through scale patterns is not possible because of the similarity in pink salmon scale patterns from these areas. The overall, correctly classified, percentages for these models were 22.2%, 30.7%, 68.5%, 50.7%, and 51.0%, respectively, which is only slightly better than chance (18.5% maximum) for determining the stock composition percentages for these areas in any given sample (Robertson 1979). Thus, the best information obtainable from any of these models would only indicate trends in population size which are useless for catch allocation and/or management decisions.

Table 9. Number and percent of tags recovered, northern Southeastern Alaska, 1977-1980.

Release Location	Number of tagged pink salmon released	Number and percentage of tagged pink salmon recovered		
		Ocean waters	Spawning streams	Total
1977				
Hawk Inlet	9,960	265 (2.7%)	1,089 (10.9%)	1,354 (13.6%)
Point Augusta	6,172	70 (1.1%)	895 (14.5%)	965 (15.6%)
All Areas	16,132	335 (2.1%)	1,984 (12.3%)	2,319 (14.4%)
1978				
Point Augusta Shoreline	6,031	532 (8.8%)	60 (9.9%)	1,137 (18.8%)
Hawk Inlet Shoreline	6,816	727 (10.6%)	77 (11.4%)	1,503 (22.0%)
Basket Bay Shoreline	5,183	807 (15.6%)	406 (7.8%)	1,213 (23.4%)
All Areas	18,030	2,066 (11.5%)	1,787 (9.9%)	3,853 (21.4%)
1979				
Basket Bay	5,381	108 (2.0%)	699 (12.9%)	807 (14.9%)
False Point Pybus	2,980	99 (3.3%)	598 (20.1%)	697 (23.4%)
Big Bend	2,141	50 (2.3%)	335 (15.6%)	385 (17.9%)
Chaik - Point Gardner	1,057	8 (0.8%)	162 (15.3%)	170 (16.1%)
All Areas	11,559	265 (2.3%)	1,794 (15.5%)	2,059 (17.8%)

-continued-

Table 9. Number and percent of tags recovered, northern Southeastern Alaska, 1977-1980 (continued).

Release Location	Number of tagged pink salmon released	Number and percentage of tagged pink salmon recovered		
		Ocean waters	Spawning streams	Total
1980				
False Point Pybus	1,279	20 (1.7%)	135 (10.6%)	155 (12.2%)
Woewodski Harbor	568	12 (2.1%)	101 (17.8%)	113 (19.9%)
Point Gardner	771	44 (5.7%)	111 (14.4%)	155 (20.1%)
Wilson Cove	2,326	60 (2.6%)	192 (8.3%)	252 (10.9%)
Baranof Warm Springs	1	0	0	0 (0%)
Red Bluff Bay	79	2 (2.5%)	13 (16.5%)	15 (19.0%)
Kingsmill Point-Washington Bay	5,828	334 (5.7%)	423 (7.3%)	757 (13.9%)
Point Ellis	5	0	0	0 (0%)
Patterson Bay-Misty Cove	50	0	10	10 (20.0%)
Point Cosmos	265	12 (4.5%)	25 (9.4%)	37 (13.9%)
All Areas	11,172	484 (4.3%)	1,010 (9.0%)	1,494 (13.4%)

Table 10. Number of reported tag recoveries by method - northern Southeastern Alaska, 1977-1980.

Tag recovery method	Number and percent of reported recoveries			
	1977	1978	1979	1980
Alaska Department of Fish and Game stream recovery	1,644 (70.9%)	1,610 (41.8%)	1,750 (84.4%)	912 (61.2%)
Public reward system stream recovery	223 (9.6%)	154 (4.0%)	43 (2.1%)	56 (3.7%)
National Marine Fisheries Service weirs ¹	78 (3.4%)	23 (0.6%)	5 (0.2%)	29 (1.9%)
Commercial seine fishery	6 (0.2%)	1,863 (48.4%)	248 (12.0%)	305 (20.1%)
Commercial gillnet fishery	254 (10.9%)	129 (3.3%)	10 (0.5%)	145 (10.0%)
Commercial troll fishery	23 (1.1%)	38 (1.0%)	5 (0.2%)	19 (1.3%)
Sport saltwater	52 (2.2%)	29 (0.8%)	0 (0%)	0 (0%)
Unknown	39 (1.7%)	7 (0.1%)	12 (0.6%)	28 (1.9%)

¹ Auke Creek and/or Sashin Creek weirs.

Migration Patterns

Yearly migration patterns of pink salmon stocks passing through the tagging areas were analyzed for fish harvested in the major net fisheries and the escapement. The analysis was based on the estimated percentages of escapement or harvest passing through the release areas in bi-monthly time segments (i.e., late June (15-30), early July (1-15), late July (16-31), early August (1-15), and late August (16-31)).

To facilitate the analysis, it was necessary to compensate for the unequal numbers of releases between the experimental groups. This was accomplished by first determining the proportion of tagged fish recovered in each stream from each release group (i.e., number recovered in a stream divided by number released in the respective experimental group). The calculated proportions within each stream were next converted to a 100% scale for comparisons between groups. The resulting percentages were viewed as an estimate of the amount of escapement contributed from the various release groups (see Kadashan Creek example, Table 11).

The estimated contributions were calculated for each stream and were employed to study seasonal migration patterns. This was accomplished with respect to path of migration and/or run timing by adding the estimated percentages contributed from the desired combination of release categories. Separate analyses were performed for movement along each release location. The return characteristics were evaluated for each stream and, based on run timing similarities and geographical distribution, various stock groups were identified. The migration patterns of the stock groups were analyzed by combining the recovery information of the various streams within the group and then evaluating group characteristics in the same manner as the individual streams. In some instances individual streams were not placed into groups (e.g., Kadashan Creek) because they were distinctly different from others in the same area. Similarly, estimates of run timing were determined by combining individual stream timing based on percentage contribution to identify stock run timing patterns (e.g., Seymour Canal and Tenakee Inlet).

District 108:

Tag recoveries in District 108 were minimal compared to the other districts during the 4 years of this study (0, 0, 5, and 36, respectively). The analysis of the limited number of tag returns from this district indicated that the upper portion of District 108 pink salmon stocks returned through upper Chatham Strait (via Icy Strait), passed by lower Admiralty Island, "sagged" as far south as Kingsmill Point, and then turned into Frederick Sound, and on into the upper portion of the district (Figure 5).

District 109:

Tag recoveries in District 109 varied considerably during the 4 years, with the majority occurring in the Frederick Sound portion. A total of 14 tags was recovered in 1977 (1, lower Chatham; 13 Frederick Sound), 6 in 1978 (4 lower Chatham; 2 Frederick Sound), 18 in 1979 (all Frederick Sound), and 545 in 1980 (132, lower Chatham, 413 Frederick Sound). A review of the figures

Table 11. Example of percent contribution calculations, Kadashan Creek - 1977.

	Point Augusta Shore					Hawk Inlet Shore					Total
	Late June	Early July	Late July	Early August	Late August	Late June	Early July	Late July	Early August	Late August	
Number of tags recovered	34	48	12	2	0	5	25	25	2	0	153
Number of releases	548	3,425	1,636	541	22	567	2,483	1,997	3,663	1,260	16,132
Proportion of a fish recovered ¹	.0620	.0140	.0073	.0037	0	.0090	.0101	.0125	.0005	0	0.12
Percent contribution ²	52%	12%	6%	3%	0	8%	8%	10%	1%	0	100%

¹ Proportion of fish recovered = $\frac{\text{Number recovered in stream}}{\text{Total released in experimental group}}$

² Percent contribution = $\frac{\text{Proportion of fish recovered in time period} \times 100}{\text{Total of proportions}}$

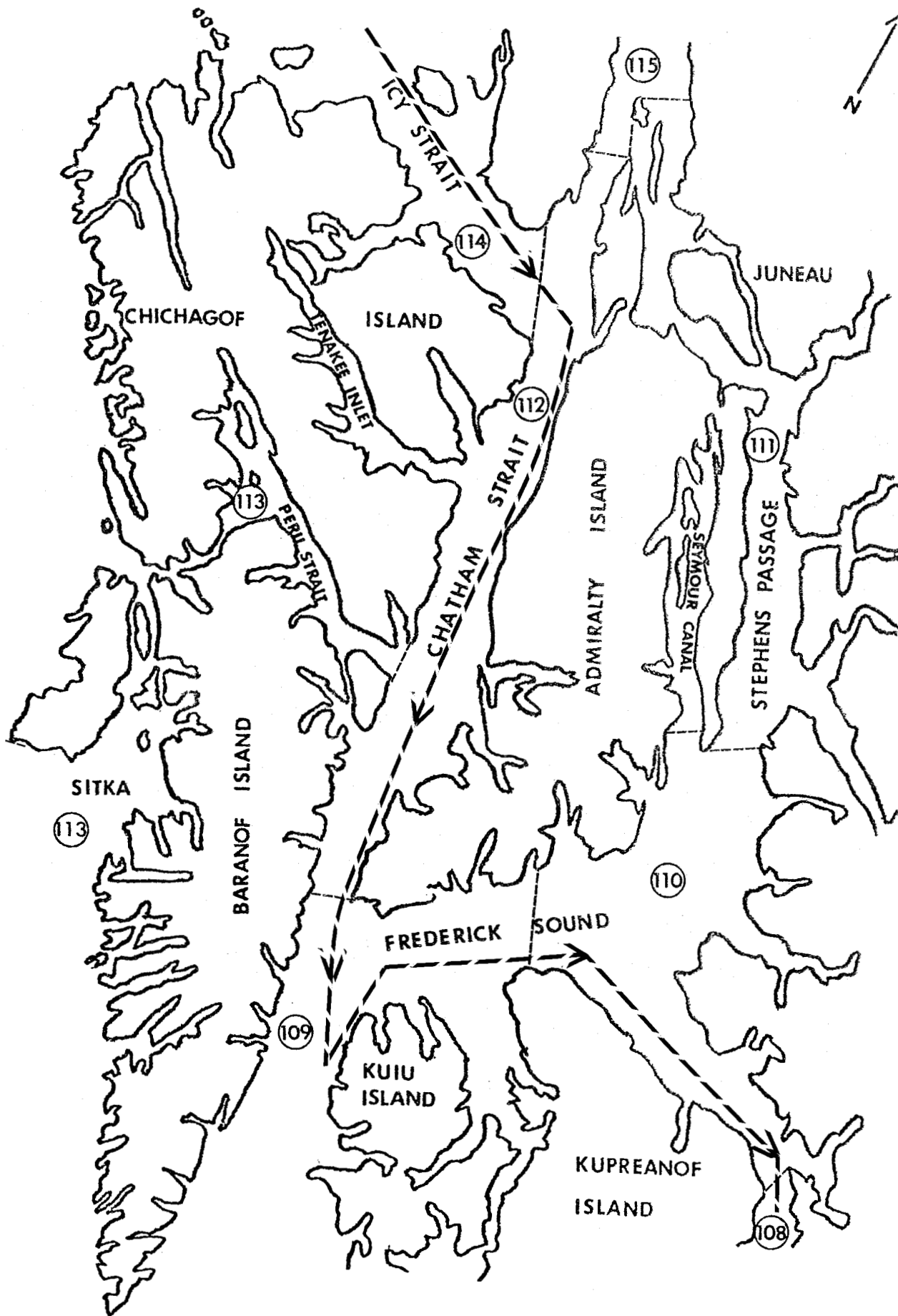


Figure 5. District 108 (upper area only) pink salmon migration patterns as indicated by commercial and stream tag recoveries, northern South-eastern Alaska, 1977-1980.

indicated that the Frederick Sound portion of this district's escapement returned via Icy Strait and upper Chatham Strait. On the other hand, as indicated by 1980 tag returns, the lower Chatham portion of this district's escapement returned through the entrance to lower Chatham rather than Icy Strait and upper Chatham Strait (Figure 6).

District 110:

Tag recoveries in District 110 were fairly small during the first 2 years but increased considerably during the last 2 years. A total of 27 tags was recovered in 1977, 46 in 1978, 555 in 1979, and 344 in 1980. A review of the figures indicated that large portions of this district's pink salmon stocks returned through upper Chatham Strait, migrated down through middle Chatham Strait, sagged as far south as Kingsmill Point, and then turned into Frederick Sound and District 110 (Figure 7).

District 111:

Tag recoveries in District 111 were substantial during all 4 years. A total of 566 tags was recovered in 1977 (77, Seymour Canal; 489, Stephens Passage), 533 in 1978 (468, Seymour Canal; 65, Stephens Passage), 237 in 1979 (25 in Seymour Canal; 212 in Stephens Passage), and 398 in 1980 (240 in Seymour Canal; 158 in Stephens Passage). A review of the tag and recovery data from this district indicated that the pink salmon escapement to this area returned via two migration routes. All pink salmon returning to District 111 entered through Icy Strait and passed into upper Chatham Strait. Once inside upper Chatham Strait, however, a major portion of these stocks migrated up Chatham Strait, around the northern tip of Admiralty Island, and passed into upper Stephens Passage and the Taku River-Snettisham drainage tributaries. The remaining portion (mostly Seymour Canal and some Taku River-Snettisham stocks) migrated south through middle Chatham Strait and around the southern tip of Admiralty Island into lower Frederick Sound. From this area these stocks moved northward into Seymour Canal and Stephens Passage (Figure 8).

District 112:

Tag recoveries in District 112 were also substantial during all 4 years of the study. A total of 1,194 tags was recovered during 1977 (217, Tenakee Inlet; 689, upper Chatham Strait; and 288, middle Chatham Strait), 2,370 in 1978 (1,253 in Tenakee Inlet; 898, upper Chatham Strait; and 219, lower Chatham Strait), 796 in 1979 (476, Tenakee Inlet; 196, upper Chatham Strait; and 124 in lower Chatham Strait), and 125 in 1980 (21, Tenakee Inlet; 15, upper Chatham Strait; and 89, lower Chatham Strait). A review of the tag recovery data indicated that this district's pink salmon escapement returned entirely via Icy Strait, upper Chatham Strait, and middle Chatham Strait to the various bays and inlets which are found within the area (Figure 9).

District 113 (Peril Strait Only):

Tag recoveries in District 113 (Peril Strait only) were relatively low, except for 1978, when numerous seine fisheries occurred in the district. A total of 100 tags was recovered in 1977, 1,016 in 1978, 150 in 1979, and 27 in 1980.

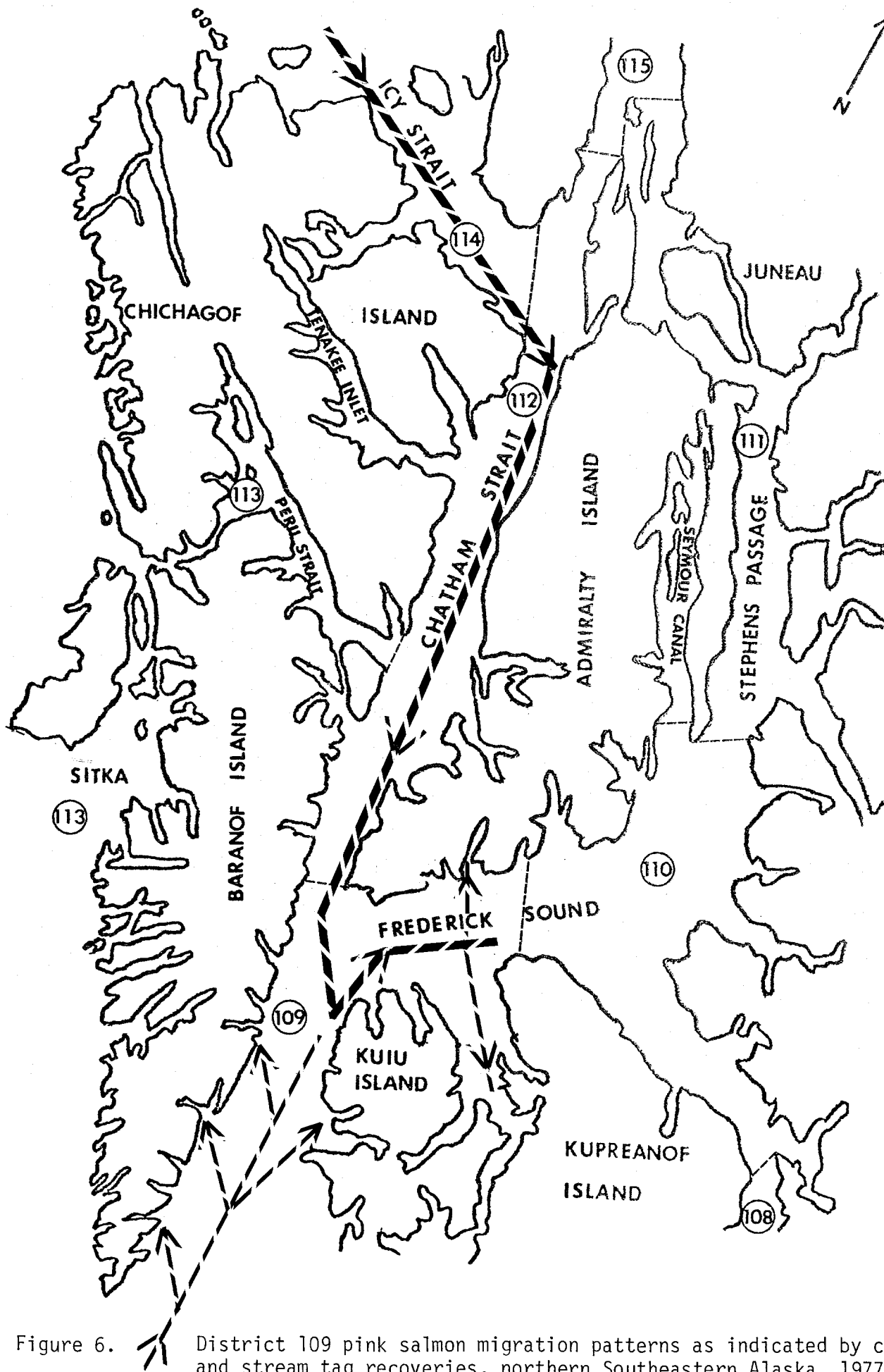


Figure 6. District 109 pink salmon migration patterns as indicated by commercial and stream tag recoveries, northern Southeastern Alaska, 1977-1980.

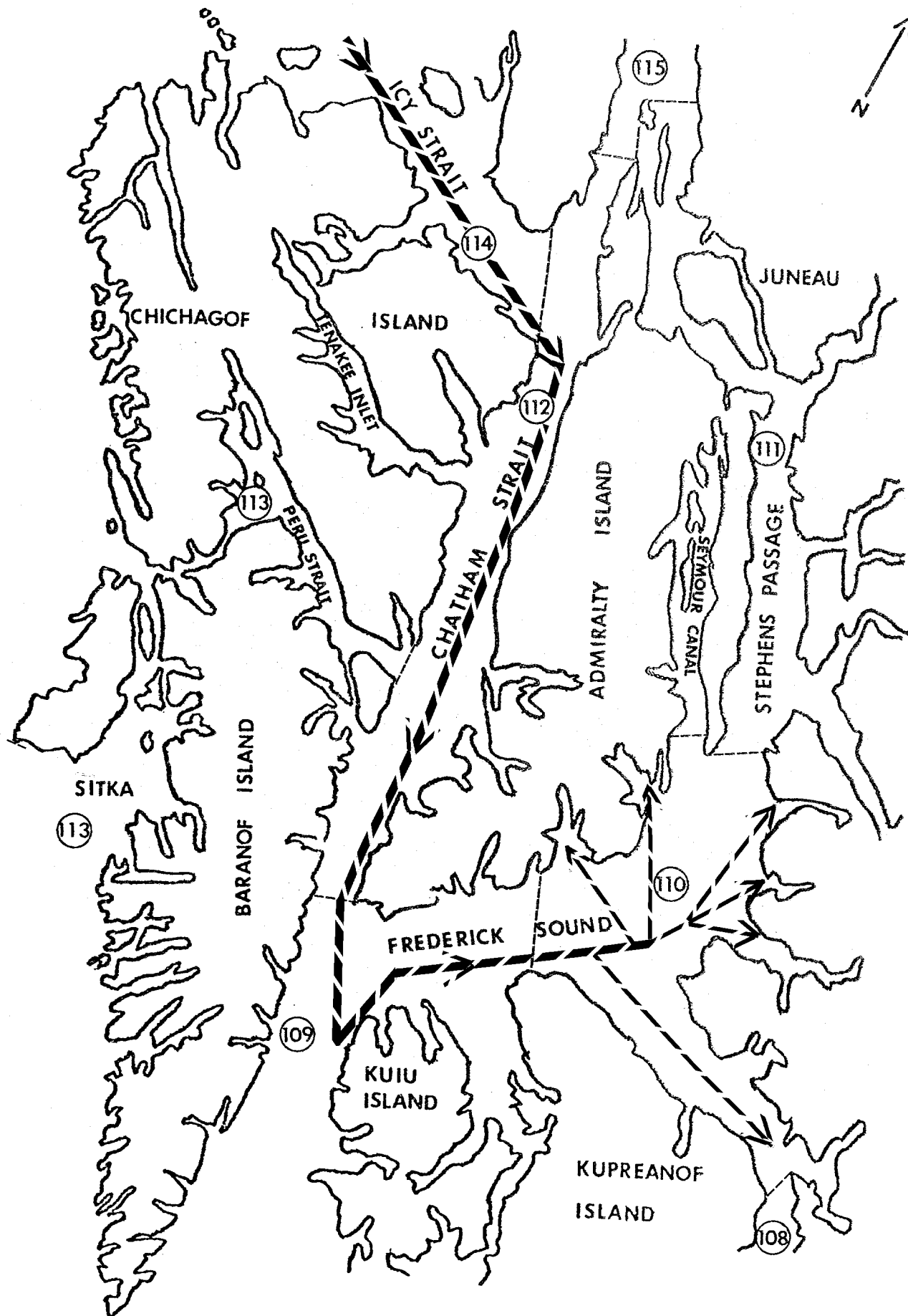


Figure 7. District 110 pink salmon migration patterns as indicated by commercial and stream tag recoveries, northern Southeastern Alaska, 1977-1980.

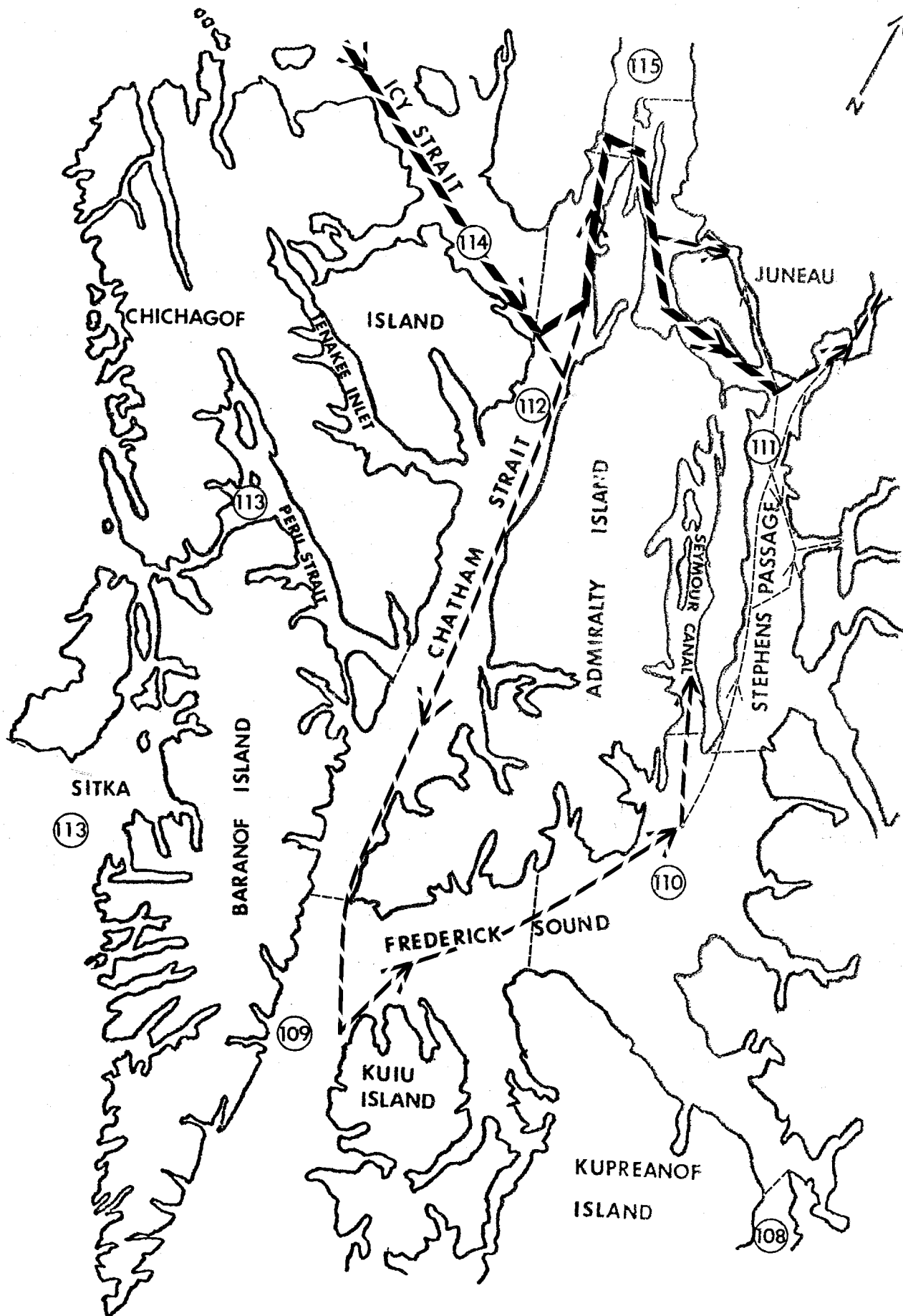


Figure 8. District 111 pink salmon migration patterns as indicated by commercial and stream tag recoveries, northern Southeastern Alaska, 1977-1980.

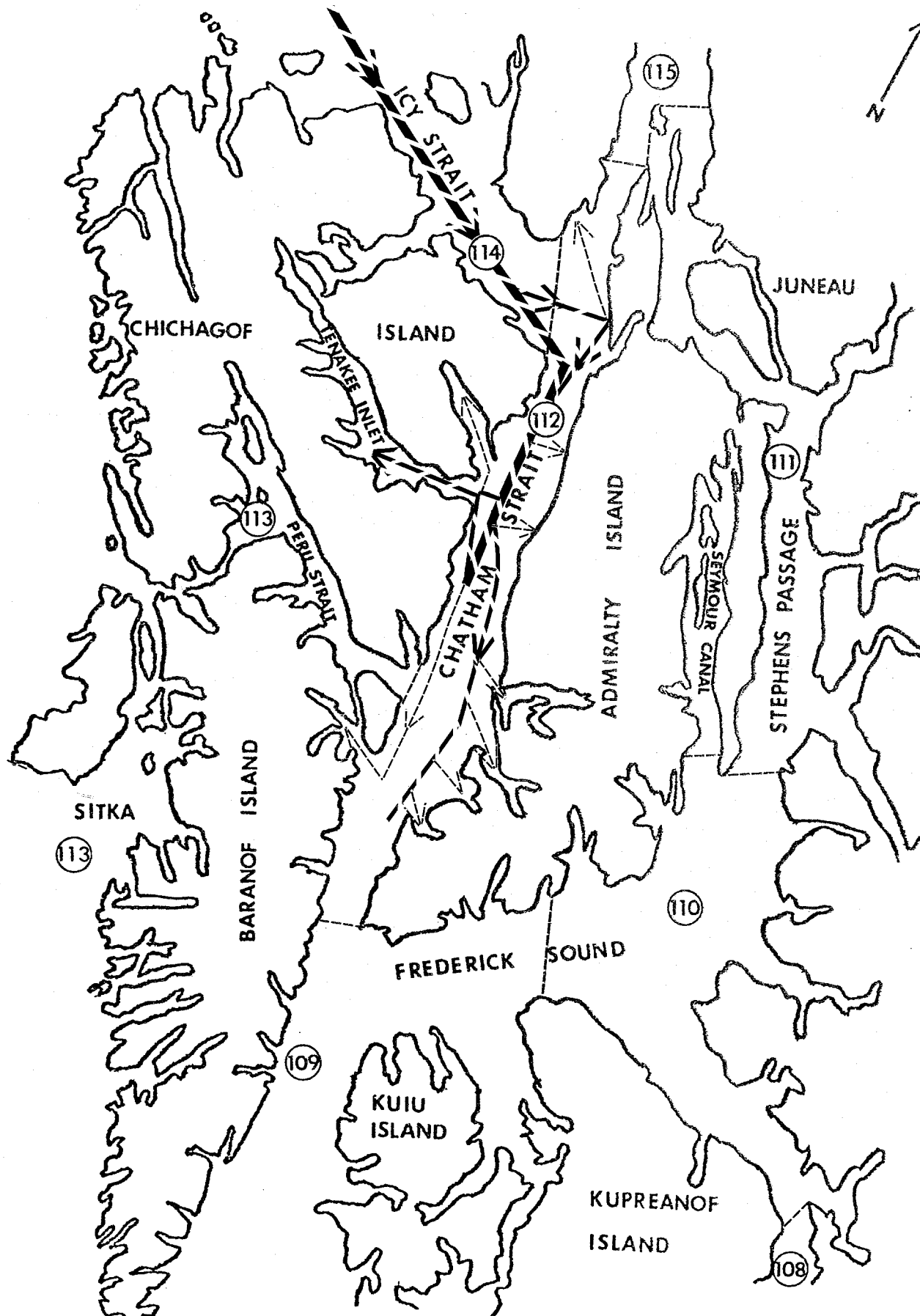


Figure 9. District 112 pink salmon migration patterns as indicated by commercial and stream tag recoveries, northern Southeastern Alaska, 1977-1980.

Analysis of the recoveries indicated that the majority of the Peril Strait stocks migrated through Icy Strait, entered upper Chatham Strait, and moved southward into middle Chatham Strait along the eastern Chichagof Island shoreline before migrating into Peril Strait and its respective spawning streams. In addition, some minor straying and milling of these stocks as far south as Frederick Sound was noted (Figure 10).

District 114:

District 114 tag recovery efforts were restricted to the easterly portions of Icy Strait (west of Port Frederick). A total of 305 tags was recovered in 1977, 90 in 1978, 2 in 1979, and 4 in 1980. A review of the tag recovery data indicated that the majority of the pink salmon stocks bound for this area's spawning streams entered through Icy Strait and sagged toward and/or into upper Chatham Strait before ascending to their home streams (Figure 11).

District 115:

Due to the distance between the release sites and the streams within the districts, tag recovery efforts in District 115 were limited. A total of 103 tags was recovered in 1977, 10 in 1978, 1 in 1979, and 3 in 1980. Although the number of tags recovered in this district was limited, information derived from the recoveries illustrated that this district's pink salmon stocks entered through Icy Strait. Once inside, the stocks moved northward through upper Chatham Strait and into Lynn Canal, after which they ascended their natal streams (Figure 12).

Run Timing

The run timing data collected during the course of this study indicates that there is usually one peak period which contributes about 50% or more of the seasonal escapement to a particular stream. Graphical illustrations of run timing data, which is based on time of passage past the release sites rather than time of spawning ground appearance, shows a seemingly normal distribution of percent contributions around the peak periods. Some streams did not demonstrate this distribution; however, they were the exceptions, and most stocks, where sufficient recoveries were available, demonstrated a normal shaped curve of movement by time through the study areas.

Three major run timing categories were apparent from the 1977 tag and recovery information. The early pink salmon runs passed by the study areas from late June through mid-July. The early runs tagged in upper Chatham Strait were destined for specific areas. Early pink salmon passing through this area were destined for spawning grounds located in Districts 110, 111, 112 (Kadashan Creek in Tenakee Inlet only), 113 (Peril Strait only), and 114 and 115 (Appendix Table 2).

Middle run stocks were those which demonstrated a peak migration from the late July (16-31) releases. These stocks were destined for Districts 108 (upper), 109, 111, 112 (Tenakee Inlet except Kadashan Creek), 113, and the easterly half of 114 (east of Port Frederick). Thus, it appears the majority of these stocks contained a wide variety of pink salmon populations (Appendix Table 2).

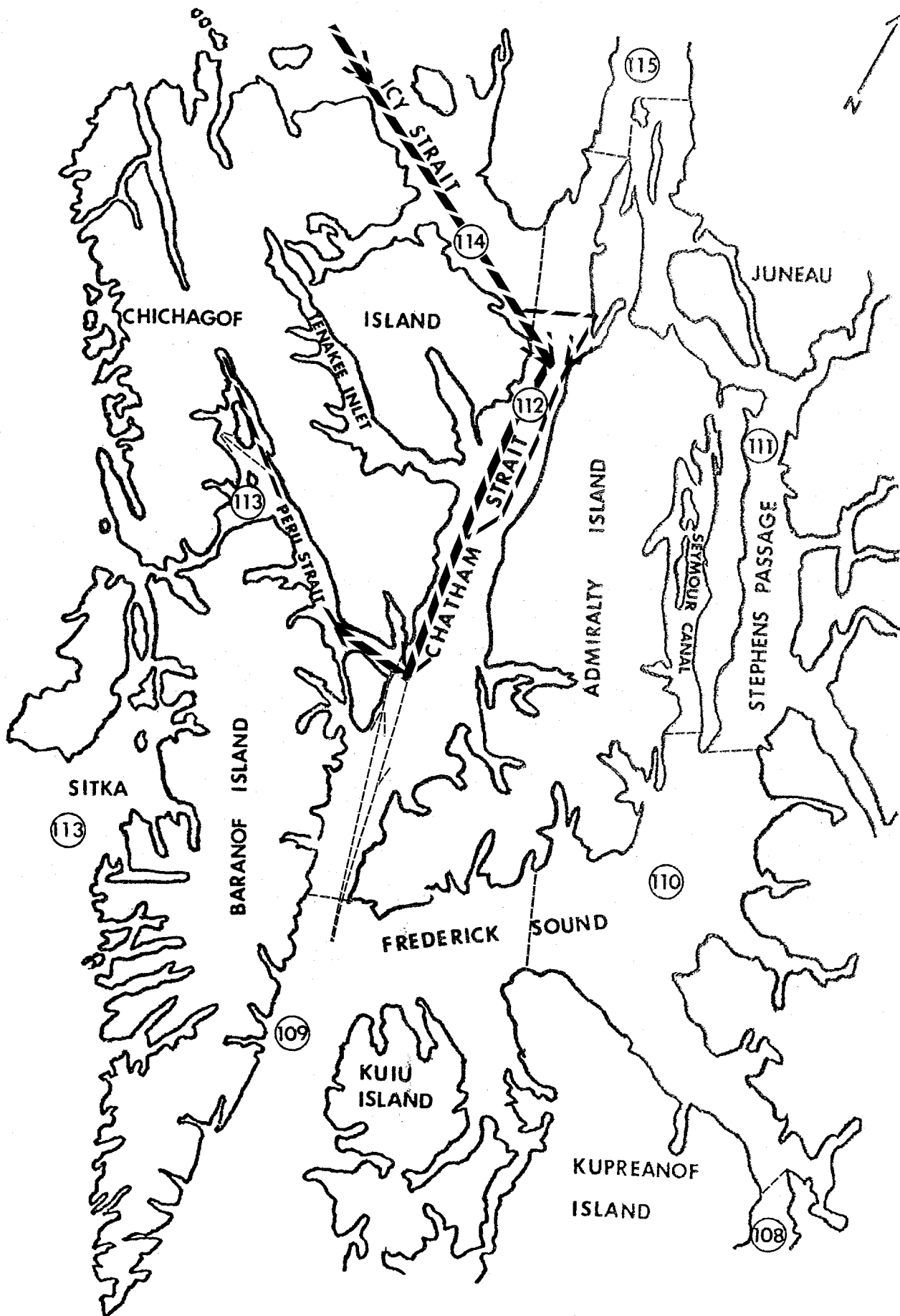


Figure 10. District 113 (Peril Strait only) pink salmon migration patterns as indicated by commercial and stream tag recoveries, northern South-eastern Alaska, 1977-1980.

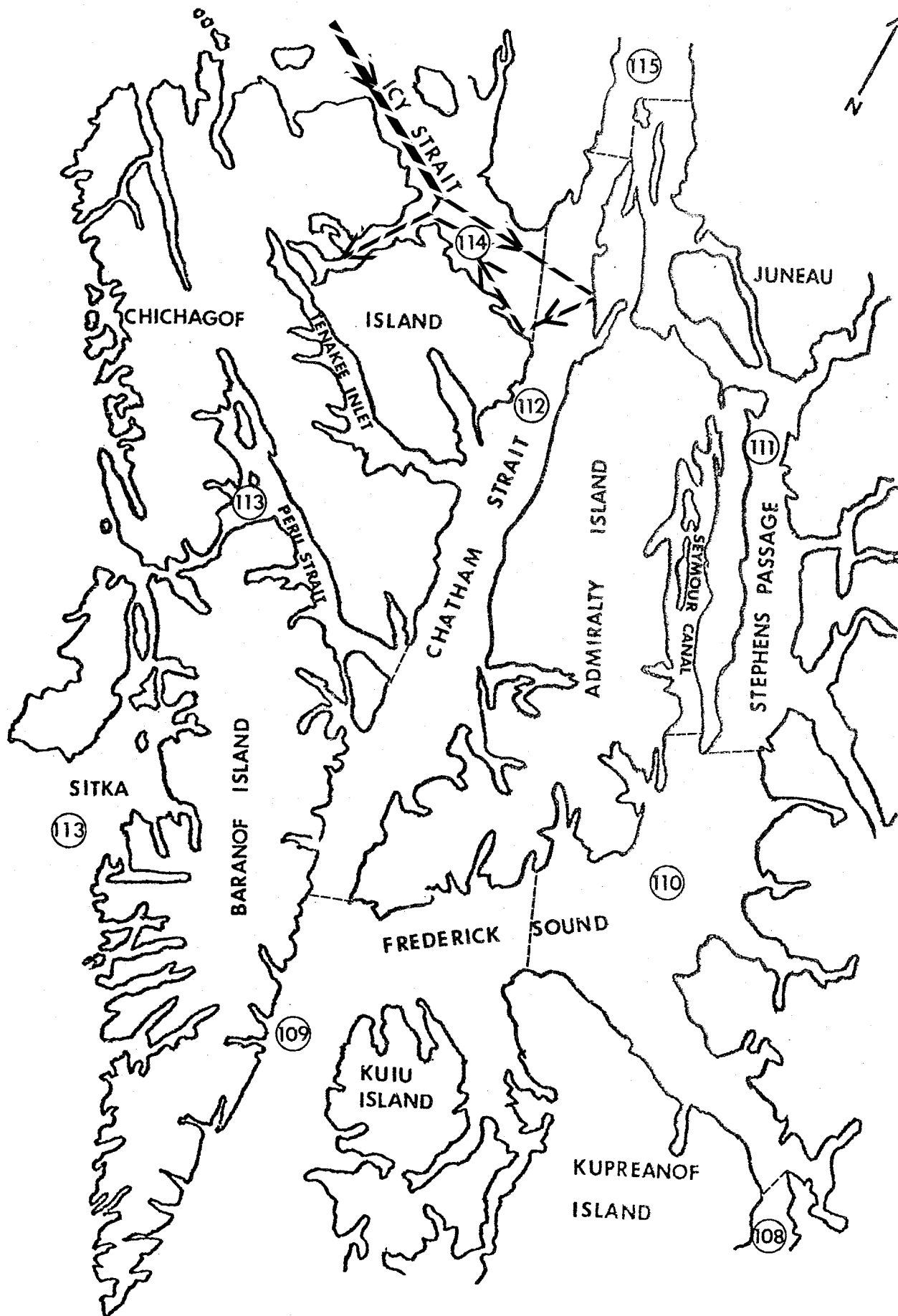


Figure 11. District 114 (easterly only) pink salmon migration patterns as indicated by commercial and stream tag recoveries, northern Southeastern Alaska, 1977-1980.

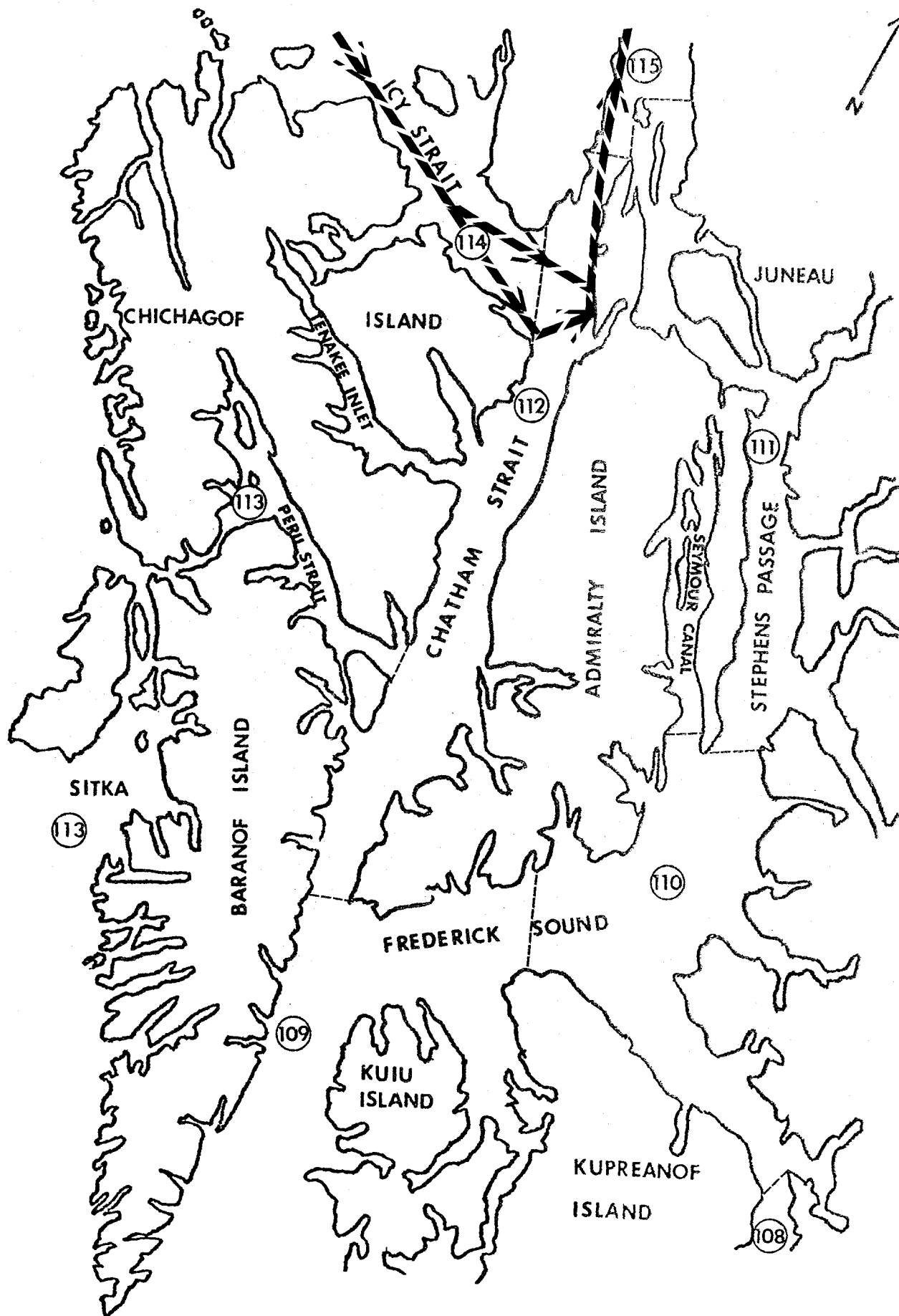


Figure 12. District 115 pink salmon migration patterns as indicated by commercial and stream tag recoveries, northern Southeastern Alaska, 1977-1980.

The late run was composed of stocks that passed through the study area predominately during August. They consisted of those spawning grounds within District 112 (Chatham Strait south of Tenakee Inlet) and one pink salmon stream in District 111 (Auke Creek near Juneau). Auke Creek is located in a predominately earlier run pink salmon area. It is a small lake-fed stream which, when combined with selection of brood stock from the late portion of the run by the National Marine Fisheries Service hatchery operating on this system, may explain the late run timing (Appendix Table 2).

During 1978 three major run timing categories were also apparent from the tag and recovery information. The early pink salmon runs passed by the study areas predominately from late June through early July and were destined for widely dispersed spawning grounds. Pink salmon passing along the Point Augusta and Hawk Inlet shorelines consisted of Districts 110, 111 (Seymour Canal and the spawning stocks located on the mainland of Stephens Passage), 112 (Tenakee Inlet, Freshwater Bay, Whiterock Creek), and 113 (Peril Strait) stocks. Early run pink salmon passing near Basket Bay were traveling to the more local spawning areas of District 112 (Tenakee Inlet, Freshwater Bay, Whiterock Creek), and Peril Strait in District 113 (Appendix Tables 2 and 3).

The middle run stock groups moved through the tagging areas predominately during the early August release period. The geographical distribution of these stocks was almost entirely restricted to Districts 112 (Chatham Strait) and 113 (Peril Strait) with minor portions of Districts 111 (Fish Creek) and 114 present (Appendix Tables 2 and 3).

The late run pink salmon displayed a peak migration for tagging conducted in late August. The late run spawning areas consisted entirely of lake-fed streams. All of these except Auke Creek (District 111), near Juneau, were located in Districts 112 (middle and upper Chatham Strait area) and 113 (Peril Strait) (Appendix Tables 2 and 3).

Two major run timing categories were apparent from the 1979 tag and recovery information. The early pink salmon runs passed by the study areas from late June through mid-July. The early run stocks tagged at the release sites were destined for specific areas. Early pink salmon passing Basket Bay were destined mainly for Districts 111, 112, and 113 (Peril Strait) spawning grounds. Those stocks passing the Chaik Bay - Point Gardner shore were destined for Districts 110, 111, 112, and 113 (Peril Strait) systems (Appendix Table 4).

The middle run stock groups moved through the tagging areas during the late July - early August release period. The geographical distribution of the middle run stocks was widely dispersed. Pink salmon released along Basket Bay were destined for Districts 112 (Freshwater Bay and upper or middle Chatham Strait) and 113 (Peril Strait) spawning systems. Chaik Bay - Point Gardner releases returned to Districts 110, 112 (Tenakee Inlet, middle Chatham Strait) and 113 (Peril Strait) spawning streams. On the other hand, False Point Pybus - Big Bend releases returned to District 109 (upper), 110, and 111 spawning streams (Appendix Table 3).

Late run stocks were not tagged in 1979 because of a lack of project funding.

Finally, two major run timing categories were apparent from the 1980 tag and recovery data. The early pink salmon runs passed by the study areas in early July and were destined for specific areas. Early pink salmon runs passing along the Wilson Cove - Point Gardner shore were destined for spawning grounds in Districts 108, 109, 110 (mainland streams), 111 (the Taku-Snettisham gillnet fishery), and minor portions of 112. Likewise, those stocks passing the Kingsmill Point - Washington Bay shoreline during the early time segment were destined for the same areas as those passing the Chaik Bay - Point Gardner shore. On the other hand, only a few early run stocks were present along the Woewodski Harbor - False Point Pybus shore (minor portions of Districts 110 and 111 stocks), while only a very small number of pink salmon were present along the remaining release sites in lower Chatham Strait (Appendix Tables 3 and 4).

The middle run stock group moved by the tagging areas during the late July - early August release period. The geographical distribution of the middle run pink salmon was widely dispersed. Pink salmon released along the Chaik Bay - Point Gardner shore were destined for Districts 108 (upper) and 113 (Peril Strait only). Middle run releases along the Kingsmill Point - Washington Bay shoreline displayed a similar distribution, while releases along the Woewodski Harbor - False Point Pybus shore dispersed to all these areas except for District 113. Tag releases made during this time period at the remaining locations (all in lower Chatham Strait) began to appear in the escapement, but were restricted to localized areas in lower Chatham Strait in District 109 (Appendix Tables 3 and 4).

Late run stocks were not tagged in 1980 because of a lack of project funding. Escapement surveys conducted during this period indicated that a dwindling number of pink salmon occurred in all the tag release sites except for lower Chatham Strait. The strong return noted to the spawning systems within this area after tagging was suspended, indicated that we missed these fish during the earlier periods of tagging at the lower Chatham Strait release sites. In addition, the dwindling number of pink salmon at the remaining 1980 release locations was even stronger evidence that those stocks (lower District 109) were late run and returned through lower Chatham Strait.

Stock Intermingling

The degree of pink salmon stock intermingling was found to vary seasonally and between release sites. Within a 6 week period most of the inside pink salmon stocks were noted to pass through Chatham Strait and Frederick Sound. During each year of the study distinct differences in run timing were apparent for some stocks, while overlap and similarities were noted for many others.

Throughout the 1977 tagging season a heterogeneous mixture of pink salmon stocks were present in upper Chatham Strait. Distinct differences in run timing were apparent for some stocks, however, overlap and similarities were indicated between many groups (Larson 1978).

The most heterogeneous mixture occurred during July (when significant numbers of most northern Southeastern Alaska pink salmon stocks passed through the study areas. This was particularly true for mid-July when a shift from early

to middle run fish occurred. Fish present in August tended to be more localized stocks. By then a vast majority of the early runs had passed through and most pink salmon present seemed to be destined for Chatham Strait spawning stream.

During the 1978 tagging season considerably less intermingling of stocks was evident for pink salmon moving along the Basket Bay shoreline as opposed to either side of upper Chatham Strait (Hawk Inlet or Point Augusta). Recoveries from the Point Augusta and Hawk Inlet tagging experiments were numerous in Districts 101-104, however, virtually all (98%) of the recovered tags from the Basket Bay releases were made of Districts 112 and 113 in the Peril Strait portion only (Larson 1978).

The most heterogeneous mixture of pink salmon stocks in 1978 was noted to occur in late July. During that time major portions of the early run stocks were present in Chatham Strait along with important segments of the local middle run pink salmon. Starting in late July and continuing through August the stock composition tended to be composed of local, returning pink salmon. Throughout August most of the pink salmon present were a more homogeneous group destined for local Chatham Strait spawning grounds.

Throughout the 1979 tagging season a limited amount of intermingling was evident along the release sites at Basket Bay, Chaik Bay - Point Gardner, and False Point Pybus - Big Bend shorelines. The majority of recovered tags from Basket Bay releases were made in Districts 112 and 113 (Peril Strait only). Tags recovered from Chaik Bay - Point Gardner releases were found mainly in local systems or Districts 109, 110, and 111. Similarly, recovered tags from False Point Pybus - Big Bend releases appeared locally in Districts 109, 110, and 111 (Hoffman 1980).

The most heterogeneous mixture of pink salmon stocks was noted to occur along the Basket Bay, and to some extent, along the Chaik Bay - Point Gardner shoreline in July. During that time major portions of the early run stocks were interspersed with important segments of the middle run stocks. Starting in late July, and into early August, the stock composition tended to be mostly middle run fish.

On the other hand, a homogeneous stock of pink salmon was found to exist along the False Point Pybus - Big Bend shoreline. Early run fish were not present in any numbers in this area and large numbers of returning fish were not present until late July. Thus, the majority of fish present along this shore consisted of middle run stocks destined for District 101 and 111.

During the 1980 tagging season a high degree of stock intermingling was evident at most of the release sites. A heterogeneous group of pink salmon stocks were evident along the Chaik Bay - Point Gardner, Kingsmill Point - Washington Bay, and Woewodski Harbor - False Point Pybus shorelines from which the majority of tags were recovered in Districts 108-112. On the other hand, a more homogeneous group of pink salmon was noted to occur in lower Chatham Strait as detected by the tags recovered from Point Cosmos, Patterson Bay, and Red Bluff Bay which were localized in the spawning streams lower Chatham Strait in District 109 (Hoffman 1981).

MANAGEMENT IMPLICATIONS

The migration patterns, run timing, and intermingling of pink salmon stocks demonstrated by the 4 years of this study illustrated the complex nature of pink salmon management in the inside waters of northern Southeastern Alaska.

The distribution of recoveries showed that fishing in Chatham Strait would effect escapement to all the northern inside water spawning grounds. These included important spawning streams in the three northern Southeastern Alaska management areas: Juneau, Petersburg, and Sitka.

Movement of pink salmon through Chatham Strait and Frederick Sound was shown to occur in somewhat of an orderly manner. Peak migration periods were noted for individual stocks and larger stock units. These seemed to suggest that fishing seasons could be adjusted according to peak escapement periods to protect, or direct harvest to, selected stock groups.

Based on results obtained the following points are suggested as having important management implications.

- 1) Pink salmon passing through Chatham Strait are almost exclusively northern Southeastern Alaska inside stocks.
- 2) Throughout the season large numbers of pink salmon destined for the three northern Southeastern Alaska management areas (Juneau, Petersburg, and Sitka) are available in Chatham Strait.
- 3) A major difference was indicated for the time of passage through upper Chatham Strait by Kadashan Creek pink salmon as opposed to other Tenakee Inlet stocks (late June for Kadashan and late July for other stocks).
- 4) Icy Strait pink salmon stocks as far westward as Port Frederick sag toward, and even enter, upper Chatham Strait prior to ascending their spawning streams.
- 5) The most heterogenous mixture of pink salmon stocks passing through upper Chatham Strait occurs in July.
- 6) Pink salmon present in upper Chatham Strait during August are predominately local Chatham Strait stocks.
- 7) The distribution of recovered tags demonstrated that fishing along both sides of upper Chatham Strait effects escapements to the inside spawning streams of District 108-115.
- 8) The reported tag recoveries strongly suggest that fishing along the Basket Bay shoreline effects escapements to Districts 112 and 113 (Peril Strait portions only), however, only a minimal percentage of Districts 110 and 111 returning stocks would be harvested.

- 9) A considerable portion of the Tenakee Inlet and Freshwater Bay stocks were noted to sag southward in Chatham Strait, at least to the vicinity of Basket Bay, prior to entering their respective home areas.
- 10) Tag recovery information suggests that only a minimal portion of the pink salmon destined for Chatham Strait streams north of Freshwater Bay and the adjoining portions of eastern Icy Strait sag southward to Basket Bay during their spawning migrations.
- 11) Pink salmon stocks of eastern Icy Strait were noted to sag into Chatham Strait and along the Hawk Inlet shore prior to ascending their natal streams.
- 12) The early run stocks present the most severe obstacles to sound stock concept harvesting of pink salmon in Chatham Strait. Through mid-July the fish present are destined for major local and distant spawning grounds. Estimates of return strength in the more distant spawning areas would be difficult to obtain in a timely manner for harvesting surpluses in Chatham Strait.
- 13) The most heterogenous mixture of pink salmon stocks was noted in middle Chatham Strait in July while a homogenous group was found in Frederick Sound adjacent to lower Admiralty Island during the same time period.
- 14) Tag release and recovery information indicates that the District 110 mainland pink salmon stock's peak passage by lower Admiralty Island is up to 2 weeks earlier than the District's stocks bound for lower Admiralty Island streams.
- 15) The lack of recoveries from Woewodski Harbor - False Point Pybus releases versus the number of recoveries from Chaik Bay - Point Gardner and Kingsmill Point - Washington Bay releases in lower Chatham Strait indicated that some lower Chatham Strait stocks sagged up to, and mill in the vicinity of Frederick Sound - Chatham Strait confluence before returning to their natal streams.
- 16) The distribution of recovered tags suggest that the majority of upper District 108, District 109 - Frederick Sound, District 101, and District 111 (lower portion) pink salmon stocks enter through Icy Strait, migrate down Chatham Strait, and up through Frederick Sound and lower Stephens Passage to their natal streams.
- 17) The small number of tag recoveries from Chaik Bay - Point Gardner, Kingsmill Point - Washington Bay, and Woewodski Harbor - False Point Pybus releases in lower Chatham Strait indicates that these stocks are late run and returned through lower Chatham Strait.
- 18) A considerable portion of the upper District 108, Districts 109, 110, and 111 pink salmon stocks sag southward to the Kingsmill Point - Washington Bay shoreline as they migrate down Chatham Strait and

around the southern tip of Admiralty Island (Point Gardner).

- 19) Tag recovery information indicates that a considerable portion of the Taku River - Snettisham pink salmon stocks migrate down Chatham Strait, around southern Admiralty Island, and up Stephens Passage as they return to their natal streams.
- 20) The peak migration time by lower Admiralty Island pink salmon stocks returning to the Taku River and Snettisham drainage is up to 2 weeks earlier than remainder of District 111 stocks passing by this area.
- 21) Tag recovery information indicates that a minor portion of the District 112 and District 113 (Peril Strait only) pink salmon stocks sag southward in Chatham Strait as far as the Kingsmill Point - Washington Bay shoreline before returning to their natal streams.
- 22) A small portion of lower southwest Admiralty Island pink salmon stocks (Hood Bay, Chaik Bay, Whitewater Bay, and Wilson Cove) sag as far south as Kingsmill Point (Kuiu Island) before returning to their natal streams.
- 23) The most heterogeneous mixture of pink salmon stocks was noted along the Chaik Bay - Point Gardner and Kingsmill Point - Washington Bay shorelines. This suggests that derivation of sound stock concept management strategies for harvesting pink salmon at these locations (especially at Kingsmill Point) would be difficult as a result of the mixture of stocks both temporally and geographically.
- 24) The most homogeneous stock of pink salmon occurred along the Point Cosmos, Patterson Bay, and Red Bluff Bay release sites in lower Chatham Strait during 1980. The majority of fish returning to the lower Chatham Strait streams appeared to consist of late run stocks. This suggests that derivation of sound stock management strategies for harvesting pink salmon at these locations is achievable because of the homogeneous mixture of fish in these areas.
- 25) Fishery openings along the Chaik Bay - Point Gardner and Kingsmill Point - Washington Bay shorelines in early July would target on Districts 110, 111, and 112 pink salmon stocks.
- 26) Fishery openings along the Chaik Bay - Point Gardner, Kingsmill Point - Washington Bay, and Woewodski Harbor - False Point Pybus shorelines in late July through early August would target on Districts 109-113 pink salmon stocks. Districts 109, 110, and 111 stocks would be the predominant catch during this period.
- 27) Fishery openings along the Point Cosmos, Patterson Bay, and Red Bluff Bay shorelines from mid-August on would harvest predominately late run stocks destined for lower Chatham Strait spawning streams.
- 28) Fishery openings along the Point Augusta and Hawk Inlet shorelines in early July would target on Districts 111, 112, and 113 pink salmon stocks.

- 29) Fishery openings along the Point Augusta and Hawk Inlet shorelines in late July - early August would target on Districts 111, 112, 113, and 114 pink salmon stocks.
- 30) Fishery openings along the Point Augusta and Hawk Inlet shorelines in mid-August would target on District 112 pink salmon stocks.
- 31) Fishery openings along the Basket Bay shoreline in July and August would target mainly on Districts 112 and 113 pink salmon stocks.
- 32) Contrary to the results of previous studies, only a minor movement of pink salmon migration occurred up through Chatham Strait into middle and upper Chatham Strait or Frederick Sound.
- 33) Run timing data collected during the 4 years of study indicates that fishery openings could be adjusted to protect or harvest specific district pink salmon stocks within a given area.
- 34) The effective application of run timing data for fisheries management is the most imprecise during mid-July when intermingling of specific pink salmon stocks is at its greatest.

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APPENDICES

Appendix Table 1. Distribution of tags recovered in northern Southeastern Alaska, 1977-80.

1977 areas	HAWK INLET RELEASES		POINT AUGUSTA RELEASES		
	Spawning streams	Ocean waters	Spawning streams	Ocean waters	Total recoveries
Districts 101-108 Southern Southeast	1	3	0	0	4
District 109 - lower Chatham Strait	5	0	3	0	8
District 109 Frederick Sound	2	0	4	0	6
District 110	24	0	14	0	38
District 111 Seymour Canal	24	0	17	0	41
District 111 Stephens Passage	244	175	73	38	530
District 112 Tenakee Inlet	73	0	138	1	212
District 112 Upper Chatham	455	12	269	4	743
District 112 Middle Chatham	142	3	75	0	220
District 113 Except Peril Strait and Sitkoh Bay	3	0	2	0	5

-Continued-

Appendix Table 1. Distribution of tags recovered in northern Southeastern Alaska, 1977-80 (continued).

1977 areas	HAWK INLET RELEASES		POINT AUGUSTA RELEASES		Total recoveries
	Spawning streams	Ocean waters	Spawning streams	Ocean waters	
District 113 Peril Strait & Sitkoh Bay	37	2	56	7	102
District 114	42	2	254	7	303
District 115	21	62	5	19	107

-Continued-

Appendix Table 1. Distribution of tags recovered in northern Southeastern Alaska, 1977-80 (continued).

1978 areas	POINT AUGUSTA RELEASES		HAWK INLET RELEASES		BASKET BAY RELEASES		
	Spawning streams	Ocean waters	Spawning streams	Ocean waters	Spawning streams	Ocean waters	Total recoveries
Districts 101-108							
Southern Southeast	2	4	1	0	0	1	8
District 109 - lower Chatham Strait	0	0	3	0	1	0	4
District 109 Frederick Sound	0	1	1	0	3	0	5
District 110	14	0	32	0	0	0	46
District 111 Seymour Canal	10	0	15	0	0	0	25
District 111 Stephens Passage	21	46	53	84	2	6	212
District 112 Tenakee Inlet	259	183	180	273	115	243	1,253
District 112 Upper Chatham	134	24	332	3	77	158	798
District 112 Middle Chatham	72	2	98	2	145	0	319
District 113 Excluding Peril Straits & Sitkoh Bay	0	0	0	0	1	0	1
District 113 - Peril Strait	33	254	36	268	58	367	1,016
District 114	57	2	22	3	5	1	90
District 115	3	1	3	3	0	0	10
Unknown	0	15	0	21	0	31	67

-Continued-

Appendix Table 1. Distribution of tags recovered in northern Southeastern Alaska, 1977-80 (continued).

1979 areas	BASKET BAY RELEASES		CHAIK PT. GARDNER RELEASES		FALSE PT. PYBUS RELEASES		BIG BEND RELEASES		
	Spawning streams	Ocean waters	Spawning streams	Ocean waters	Spawning streams	Ocean waters	Spawning streams	Ocean waters	Total recoveries
Districts 101-108									
Southern S.E.	0	0	2	0	3	1	0	0	6
District 109									
Frederick Sound	2	1	0	0	3	6	3	3	18
District 101	4	2	19	0	301	86	99	43	554
District 111									
Seymour Canal	3	0	21	0	238	0	206	0	468
District 111									
Stephens Passage	15	6	1	1	25	3	12	1	664
District 112									
Tenakee Inlet	368	91	12	4	1	0	0	0	476
District 112									
Upper Chatham Strait	107	1	77	1	6	0	4	0	196
District 112									
Middle Chatham Strait	99	8	8	1	4	0	4	0	124
District 113									
Excluding Peril									
Strait & Sitkoh Bay	0	1	0	0	0	0	0	0	1
District 113									
Peril Strait									
Sitkoh Bay	119	1	19	0	4	0	7	0	150
District 114	2	0	1	0	0	0	0	0	3
District 115	1	0	0	0	0	0	0	0	1
Unknown	7	0	0	0	4	0	2	0	13

-Continued-

Appendix Table 1. Distribution of tags recovered in northern Southeastern Alaska, 1977-80 (continued).

1980 areas	FALSE PT. PYBUS RELEASES		WOEWODSKI HARBOR RELEASES		PT GARDNER RELEASES		WILSON COVE RELEASES		
	Spawning streams	Ocean waters	Spawning streams	Ocean waters	Spawning streams	Ocean waters	Spawning streams	Ocean waters	Total recoveries
Districts 101-107									
Southern S.E.	0	0	0	0	0	0	0	1	1
District 108									
Frederick Sound	0	0	0	0	2	3	1	5	11
District 109									
Frederick Sound	1	0	42	5	21	20	36	25	150
District 109 - lower									
Chatham Strait	3	2	0	0	2	0	1	3	11
District 110									
Mainland	3	0	46	0	14	0	18	3	84
District 110									
Admiralty Island	60	0	1	0	21	0	42	1	125
District 111									
Seymour Canal	64	0	9	0	25	0	45	0	143
District 111									
Stephens Passage	5	17	2	5	7	13	13	12	74
District 112									
Tenakee Inlet	0	0	0	0	0	0	4	0	4
District 112									
Upper Chatham Strait	0	0	0	0	0	2	1	3	6
District 112 - Middle									
Chatham Strait	0	0	1	2	10	5	24	10	52
District 113 - excluding									
Peril Strait & Sitkoh									
Bay	0	0	0	0	0	0	0	0	0
District 113 - Peril									
Strait - Sitkoh Bay	0	0	0	0	1	0	6	0	7
District 114	0	0	0	0	0	0	0	2	2
District 115	0	0	0	0	1	0	0	0	1

-Continued-

Appendix Table 1. Distribution of tags recovered in northern Southeastern Alaska, 1977-80 (continued).

1980 areas	RED BLUFF BAY RELEASES		KINGSMILL POINT- WASHINGTON BAY RELEASES		PATTERSON BAY - MISTY COVE RELEASES		POINT COSMOS RELEASES		
	Spawning streams	Ocean waters	Spawning streams	Ocean waters	Spawning streams	Ocean waters	Spawning streams	Ocean waters	Total recoveries
Districts 101-107									
Southern S.E.	0	0	0	3	0	0	0	1	5
District 108									
Frederick Sound	0	0	21	4	0	0	0	0	36
District 109									
Federick Sound	1	0	76	184	0	0	1	0	413
District 109 Lower									
Chatham Strait	7	0	42	29	10	0	24	10	133
District 110									
Mainland	0	0	69	3	0	0	0	0	156
District 110									
Admiralty Island	0	0	66	0	0	0	0	0	191
District 111									
Seymour Canal	0	0	95	0	0	0	1	0	239
District 111									
Stephens Passage	0	0	10	73	0	0	0	1	158
District 112									
Tenakee Inlet	0	1	6	8	0	0	0	2	22
District 112 Upper									
Chatham Strait	0	0	7	5	0	0	0	0	18
District 112 Middle									
Chatham Strait	3	0	27	7	0	0	0	0	89
District 113 Excluding									
Peril Strait & Sitkoh									
Bay	0	0	1	1	0	0	0	0	2
District 113 Peril									
Strait - Sitkoh Bay	2	0	18	1	0	0	0	0	27
District 114	0	0	2	0	0	0	0	0	4
District 115	0	1	1	0	0	0	0	0	3

Appendix Table 2. Percentage of pink salmon tag recoveries, by year, release time, and district of recovery for Hawk Inlet and Point Augusta releases.

Year	Release time	HAWK INLET							Total
		District of Recovery							
		108 & 109	110	111	112	113	114	115	
1977	Early	0.5	2.0	47.6	34.4	4.8	3.4	7.3	42.7
	Middle	1.3	1.0	14.9	70.2	5.1	3.9	3.6	51.9
	Late	1.0	0.0	10.4	84.5	2.1	1.0	1.0	5.4
	TOTAL	0.9	1.3	28.8	55.6	4.9	3.5	5.0	100.0
1978	Early	0.0	4.5	14.4	52.6	28.5	0.0	0.0	26.1
	Middle	0.1	1.6	9.8	62.5	22.8	2.7	0.5	58.4
	Late	0.9	0.0	5.3	86.7	5.3	0.9	0.9	15.5
	TOTAL	0.2	2.1	10.3	63.6	21.7	1.7	0.4	100.0
<u>POINT AUGUSTA</u>									
1977	Early	0.6	3.0	15.9	55.6	8.4	14.3	2.1	59.8
	Middle	1.2	1.2	3.3	50.3	7.1	35.9	0.9	40.1
	Late	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.1
	TOTAL	0.8	2.3	10.9	53.5	7.9	23.0	1.6	100.0
1978	Early	0.3	1.6	8.7	60.2	28.1	0.9	0.2	56.1
	Middle	0.3	1.0	3.7	58.3	26.4	9.8	0.5	36.3
	Late	0.0	0.0	9.4	61.1	12.9	15.3	1.2	7.6
	TOTAL	0.3	1.3	6.9	59.6	26.3	5.2	0.4	100.0

Appendix Table 3. Percentage of pink salmon tag recoveries, by year, release time, and district of recovery for Basket Bay and False Point Pybus - Woewodski Harbor releases.

Year	Release time	BASKET BAY							Total
		District of Recovery							
		108 & 109	110	111	112	113	114	115	
1978	Early	0.3	0.0	0.9	46.9	51.9	0.0	0.0	28.5
	Middle	0.3	0.0	0.8	59.5	38.5	0.8	0.0	51.9
	Late	0.4	0.0	0.0	85.8	13.4	0.4	0.0	19.6
	TOTAL	0.3	0.0	0.7	61.1	37.4	0.5	0.0	100.0
1979	Early	0.2	0.8	4.1	88.2	6.5	0.0	0.2	60.1
	Middle	0.6	0.9	1.2	69.1	27.5	0.6	0.0	39.9
	Late	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	0.4	0.9	2.9	80.6	14.9	0.2	0.1	100.0
<u>FALSE POINT PYBUS - WOEWODSKI HARBOR</u>									
1979	Early	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Middle	1.8	49.8	45.6	1.7	1.1	0.0	0.0	100.0
	Late	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	1.8	49.8	45.6	1.7	0.0	0.0	0.0	100.0
1980	Early	0.0	50.0	50.0	0.0	0.0	0.0	0.0	0.8
	Middle	19.4	41.5	38.0	1.1	0.0	0.0	0.0	99.2
	Late	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	19.2	41.5	38.1	1.1	0.0	0.0	0.0	100.0

Appendix Table 4. Percentage of pink salmon tag recoveries by year, release time, and district of recovery for Chaik Bay - Point Gardner, Kingsmill Point, Patterson Bay - Red Bluff Bay, and Point Cosmos.

		POINT GARDNER - CHAIK BAY							
Year	Release time	District of Recovery							Total
		108 & 109 ¹	110	111	112	113	114	115	
1979	Early	1.2	12.2	22.0	53.7	10.9	0.0	0.0	50.3
	Middle	1.2	11.1	1.2	72.8	12.3	1.2	0.0	49.7
	Late	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	1.2	11.7	11.7	63.1	11.7	0.6	0.0	100.0
1980	Early	7.5	29.9	59.7	3.0	0.0	0.0	0.0	16.4
	Middle	34.0	21.1	22.3	19.6	2.1	0.5	0.3	83.6
	Late	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	29.7	22.5	28.4	16.9	1.7	0.5	0.3	100.0
<u>KINGSMILL POINT</u>									
1980	Early	22.1	26.0	42.7	7.6	1.5	0.0	0.0	17.6
	Middle	52.8	16.3	19.8	7.8	2.8	0.3	0.2	82.4
	Late	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	47.4	18.0	23.8	7.8	2.6	0.3	0.1	100.0
<u>PATTERSON BAY - RED BLUFF BAY</u>									
1980	Early	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Middle	72.0	0.0	0.0	16.0	8.0	0.0	4.0	100.0
	Late	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	72.0	0.0	0.0	16.0	8.0	0.0	4.0	100.0

-Continued-

Appendix Table 4. Percentage of pink salmon tag recoveries by year, release time, and district of recovery for Chaik Bay - Point Gardner, Kingsmill Point, Patterson Bay - Red Bluff Bay, and Point Cosmos (continued).

Year	Release time	POINT COSMOS							Total
		District of Recovery							
		108 & 109 ¹	110	111	112	113	114	115	
1980	Early	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Middle	84.8	0.0	6.1	9.1	0.0	0.0	0.0	100.0
	Late	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	84.8	0.0	6.1	9.1	0.0	0.0	0.0	100.0

1. Early = June 15 - July 15
2. Middle = July 16 - August 15
3. Late = August 16 - September 15

¹ Districts 108 and 109 were grouped due to small number of recoveries.

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